MODEL 5524

DIGITAL VOLTMETER

5524-S-2056

DANA

Dana Laboratories Incorporated
Irvine, California 92664

Telephone (714) 833-1234
Teletype 910-595-1136

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SECTION 1

INTRODUCTION

1.1 SCOPE

1.2. This manual covers installation, operation, and maintenance information for the Dana Model 5524 Digital Voltmeter (Figure 1.1). The manual is intended for use by personnel responsible for operation and/or maintenance of the equipment. The information includes the physical description, a detailed description of the principles of operation,and maintenance and troubleshooting guides.

1.3 PURPOSE OF EQUIPMENT

1.4. The Model 5524 Digital Voltmeter is a multiple-function instrument capable of measuring dc voltage (filtered or unfiltered), dc/dc ratios, dc voltage in millivolts, resistance in kilohms and ac voltage. The output is displayed on a five digit visual readout with a sixth "overrange" digit that extends each range by 10% (99999 to 109999). An optional Remote Program Accessory enables the function, range, and read commands to be made externally. In addition, an optional Electrical Output Accessory provides an isolated binary-coded decimal (BCD) output for driving a printer or other recording device. A sealed case enables the instrument to withstand severe environmental conditions (see "Specifications", 1.13).

1.5. Automatic ranging (Auto Range), circuits within the instrument deter-

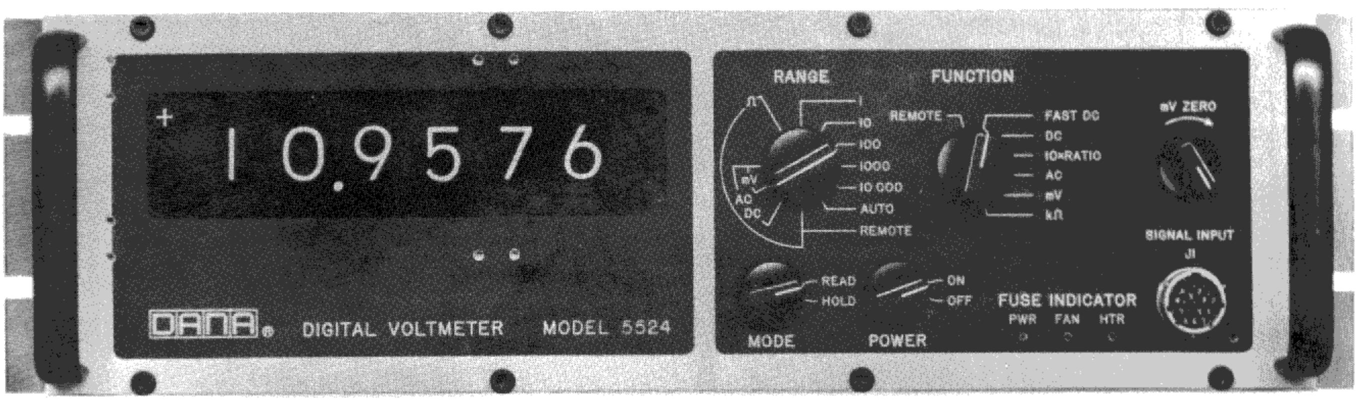
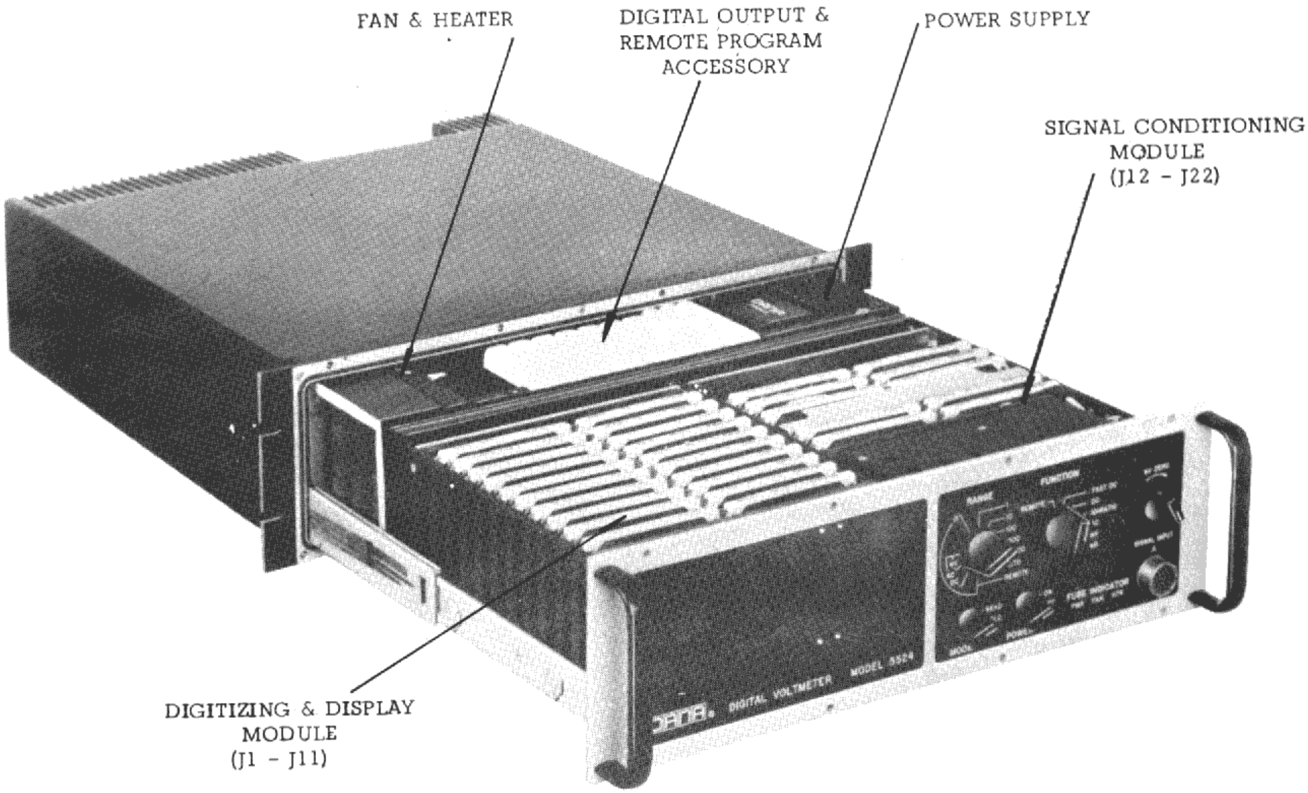
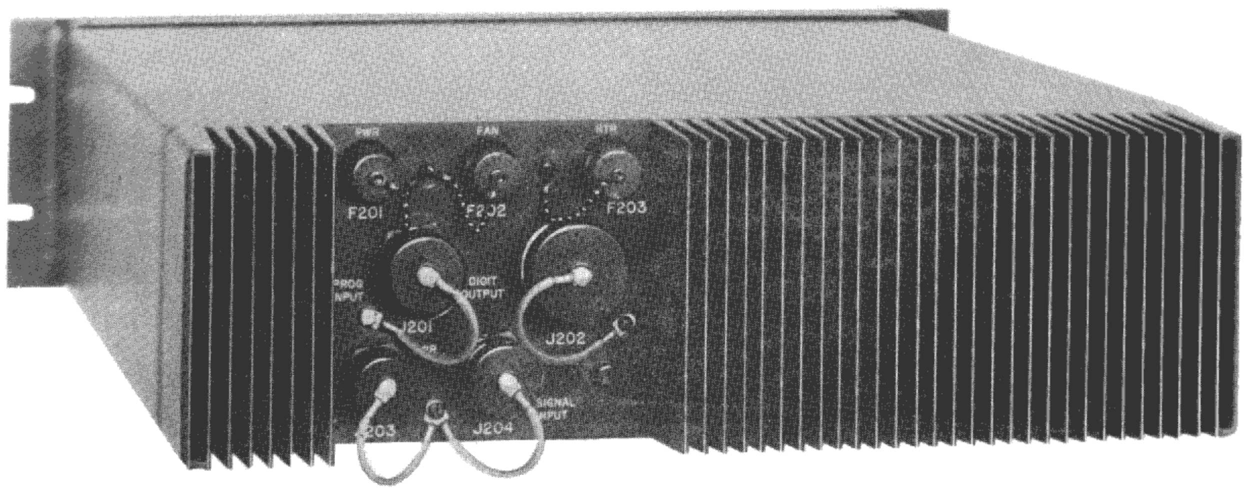


Figure 1.1. Model 5524 Digital Voltmeter



(a) Operating Controls and Circuit Board Locations



(b) Rear Panel Connectors

Figure 1.2. Connectors and Operating Controls

mine the optimum range for the function being measured and switch to that range automatically. Automatic polarity detecting circuits (Auto Polarity) determine the polarity of the input signal and display or prints this information with the output.

1.6 MECHANICAL DESCRIPTION

1.7. All circuits, except the power supply, are mounted on plug-in printed circuit boards. The boards are installed in the chassis which slides into the sealed case on rollers. All input/output connections are made through sealed glass connectors mounted on the sealed case.

1.8. All operating controls are mounted on the front panel of the instrument. Input connectors, wired in parallel, are mounted on both the front (J101) and rear (J204) panels. They carry the input signal, and the reference input used for ratio measurements. On the rear panel are the power connector (J203), the remote program connector (J201), and the digital output connector (J202). Within the instrument are connectors J1 through J22 into which the circuit boards are installed. Figure 1-2 shows the operating controls and the locations of each connector.

1.9 ELECTRICAL DESCRIPTION (Block diagram: Figure 1.3)

1.10. The instrument uses the null balance technique to measure the amplitude of unknown voltages. The circuit boards in connectors J12 through J22 (signal conditioning circuitry) develop a ten-volt full scale (plus overrange) analog voltage of the input which may be either an ac, dc, or ohms measurement. A current, proportional to this voltage, is balanced against a precise current developed from an internal reference voltage in the digitizing and display circuits (J1-J11). The "balancing" of these currents is done by a series of trial-and-error-currents developed from the known reference voltage and compared with the current from the signal conditioner. Precision resistors in the Digital to Analog Converter (DAC) divide the reference current into 100,000 equally-spaced current increments. The closest increment is determined in a maximum of 45 trials. When a null balance has been achieved, the digital setting of the DAC is displayed on the visual readout. The number shown is the ratio of the input signal to the reference voltage in parts per 100,000.

1.11. For example, if the controls are set to measure ac volts on the 100-volt range, a 50-volt input (rms) results in an internal analog voltage of 5 volts dc from the signal conditioning circuits. This is converted to a current which is balanced by an equal current derived from the internal reference voltage when the DAC arrives at a value of 50,000 (parts per 100,000). The digital display now carries the numerals 5-0-0-0-0, and range information from the signal conditioning circuits place the decimal point to read 50.000.

1.12. In the ratio measuring mode, the internal 20-volt reference is replaced by an external dc voltage, which may vary from +2 to +10.5V (ratio input of +20 to 105V optional). The displayed value is the ratio between a dc input signal and the reference voltage at that instant. The ratio between +dc voltages and the reference are shown as plus (+) ratios; the ratio between -dc voltage

Table 1.1. Connector Identification

Connector	Function
J1	Circuit Board, Display
J2	Circuit Board, 10,000 Decade
J3	Circuit Board, 1,000 Decade
J4	Circuit Board, 100 Decade
J5	Circuit Board, 10 Decade
J6	Circuit Board, 1 Decade
J7	Circuit Board, DAC
J8	Circuit Board, Null Detector
J9	Circuit Board, Sequence Logic
J10	Circuit Board, Control Logic
J11	Circuit Board, Reference and Buffer Amplifier
J12 J13 J14 J15	Assembly, Control and Attenuator
J16	Circuit Board, Isolator
J17	Circuit Board, Range Control
J18 J19	Circuit Board, AC Converter
J20	Circuit Board, Auto Polarity
J21 J22	Circuit Board, Ohms Converter
J101	Signal Input/Reference Input
J201	Remote Programming Input (rear, optional)
J202	Digital Output (rear, optional)
J203	Power (rear)
J204	Signal Input/Reference Input

and the reference as minus (-) ratios. This bipolar ratio capability (+/+ and -/+) is of particular value in applications, such as bridge balancing, where inputs are likely to pass through zero. Since the signal and reference voltages are being detected simultaneously, the accuracy of the ratio measurement is independent of the stability of the voltage source.

1.13 SPECIFICATIONS

1.14 ENVIRONMENTAL SPECIFICATIONS

(a) Temperature - Continuous operation from -40°C to 55°C. Storage temperature is from -62°C to +85°C. Intermittent operation is possible at +71°C.

(b) Humidity - 100% with condensation in the way of frost or liquid water on the equipment. Equipment to withstand this humidity during operation, and exposure in a non-operating condition.

(c) Shock - Will withstand 18 impact shocks of 15 g, consisting of three shocks in opposite directions along each of three perpendicular axes, each shock impulse having a time duration of 11 + 1 milliseconds. The g value within $\pm$10% when measured with a 0.2 to 250 Hz filter, and the maximum g occurring at approximately 5-1/2 milliseconds.

(d) Vibration - Will withstand continuous vibration along each of the three mutually perpendicular axes within the following frequency ranges and amplitudes:

Frequency	Double Amplitude
5 - 15 Hz	0.06 inch
15 - 25 Hz	0.04 inch
25 - 55 Hz	0.02 inch

(e) Interference - Interference control is in accordance with MIL-I-6181.

(f) Sand and Dust - As encountered in desert areas shall not damage equipment.

(g) Fungus - Fungus-supporting atmosphere shall not affect or damage equipment.

(h) Salt-Sea Atmosphere - Shall not damage equipment.

(i) Explosive Conditions - Equipment shall not cause ignition of explosives; gaseous atmosphere.

1.15 ELECTRICAL SPECIFICATIONS

1.16. Electrical Specifications are tabulated in table 1.2.

NOTE: Instrument meets environmental requirements of MIL 21200F when installed in its sealed outer case and with front mounting screws secured.

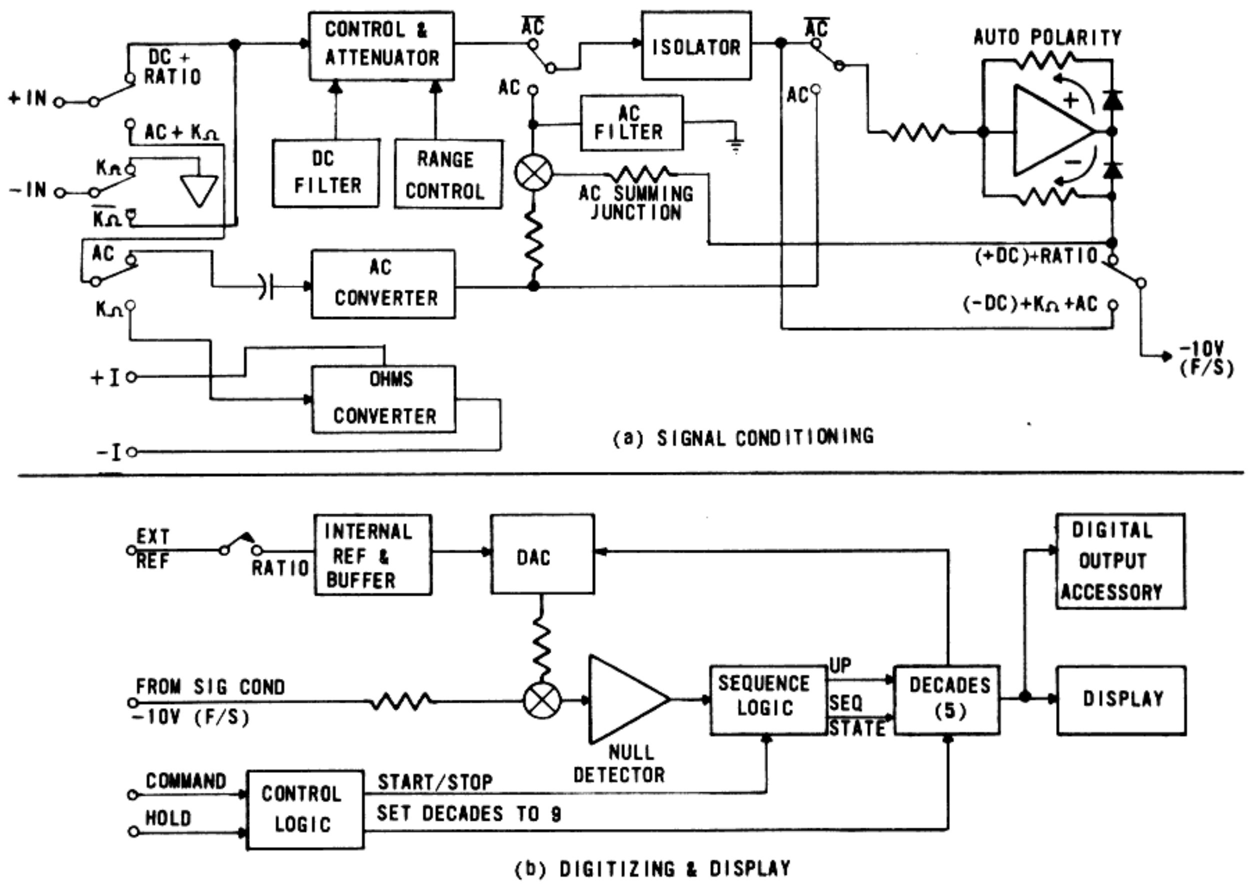


Figure 1.3. Model 5524 Block Diagram

Table 1.2. Electrical Specifications

DANA SERIES 5524 DVM SPECIFICATIONS

DC VOLTAGE MEASUREMENTS

Full scale ranges	±10.9999, ±109.999, ±1099.99 V (max 1000 V)
Accuracy	
Short term, 24 hours, 23 ±1°C	±0.005% of reading ±0.001% of f.s.
Long term stability, 6 months	±0.001% of reading per month
Temperature coefficient	±0.0005% of reading ±0.0002% of f.s. per °C
Response time: Digitizing	15 milliseconds
Digitizing with polarity change	25 milliseconds
Range change	250 milliseconds per range
Full scale step function settling time (to 0.01%)	500 milliseconds with up to 100k-ohm source
Common mode rejection: DC	140 dB with up to 100 ohms in either lead
AC, 61 Hz and below	120 dB with up to 100 ohms in either lead
Normal mode noise rejection	60dB min, 50Hz and up; increasing 18dB/octave; 80 dB min, 300Hz and above
Input resistance - at or off null: 10 range	10,000 megohms
other ranges	10 megohms

DC RATIO VOLTAGE MEASUREMENTS

Full scale ranges	±1.09999:1, ±10.9999:1, ±109.999:1
Accuracy	
Short term, 24 hours, 23 ±1°C	±0.004% of reading ±0.001 (10 V/ref)% of f.s.
Long term stability, 6 months	±0.0003% of reading per month
Temperature coefficient	±0.0005% of reading ±0.0002% of f.s. per °C
Response time: Digitizing	15 milliseconds
Digitizing with polarity change	25 milliseconds
Range change	250 milliseconds per range
Full scale step function settling time (to 0.01%)	500 milliseconds with up to 100k-ohm source
Common mode rejection: DC	140 dB with up to 100 ohms in either lead
AC, 61 Hz and below	120 dB with up to 100 ohms in either lead
Normal mode noise rejection	Same as absolute (input only)
Input resistance - at or off null: 10 range	Signal, 10,000 megohms; ref, 20 megohms
other ranges	Signal, 10 megohms; ref, 20 megohms

DC VOLTAGE MEASUREMENTS, FAST

Full scale ranges	±10.9999, ±109.999, ±1099.9 V (max 1000 V)
Accuracy	
Short term, 24 hours, 23 ±1°C	±0.005% of reading ±0.001% of f.s.
Long term stability, 6 months	±0.001% of reading per month
Temperature coefficient	±0.0005% of reading ±0.0002% of f.s. per °C
Response time: Digitizing	15 milliseconds
Digitizing with polarity change	25 milliseconds
Range change	250 milliseconds per range
Full scale step function settling time (to 0.01%)	50 milliseconds with up to 100k-ohm source
Common mode rejection: DC	140 dB with up to 100 ohms in either lead
AC, 61 Hz and below	94 dB with up to 100 ohms in either lead
Input resistance - at or off null: 10 V range	10,000 megohms
other ranges	10 megohms

MILLIVOLT MEASUREMENTS

Full scale ranges	±109.999, ±1099.00 millivolts
Accuracy, 3 months: 100mV range	±0.01% of reading ±0.02% of f.s.
1000mV range	±0.01% of reading ±0.005% of f.s.
Temperature coefficient	±0.001% of reading ±2 microvolts per °C
Response time (to 0.01%): Step response	1 second
Range change	250 milliseconds
Common mode rejection: DC	140 dB with up to 100 ohms in either lead
AC, 61 Hz and below	120 dB with up to 100 ohms in either lead
Input resistance	100 megohms minimum

AC MEASUREMENTS

Maximum voltage rating	500 V rms, 50 Hz to 10 kHz, decreasing to 150 V at 50 kHz and above
Full scale ranges	10.9999, 109.999, 1099.99 V rms
Accuracy, 3 months	50 Hz to 10 kHz: ±0.09% of rdg ±0.01% f.s. 10 kHz to 50 kHz: ±0.2% of rdg ±0.05% f.s. 50 kHz to 100 kHz: ±0.9% of rdg ±0.1% f.s.
Temperature coefficient	±0.01% of reading and ±0.0002% f.s. per °C
Response time: Step response	300 milliseconds (to 0.1%)
With range change	250 milliseconds per range
Common mode rejection: AC, 61 Hz and below	94 dB with up to 100 ohms in either lead
Input resistance (all ranges)	1 megohm in series with 0.22 microfarad
Shunt capacitance at terminals	less than 200 pF, all ranges

OHMS MEASUREMENTS

Maximum voltage across unknown	10 V at f.s., max current 10 mA on 1 kilohm range
Full scale ranges	1.09999, 10.9999, 109.999, 1099.99, 10999.9 kilohms
Accuracy, 3 months	
1, 10, 100 kilohm ranges	±0.01% of reading and ±0.001 % f.s.
1000 kilohm range	±0.03% of reading and ±0.001% f.s.
10,000 kilohm range	±0.1% of reading and ±0.001% f.s.
Temperature coefficient	
1, 10, 100 kilohm ranges	±0.002% of reading and ±0.0002% f.s.
1000 kilohm range	±0.0035% of reading and ±0.0002% f.s.
10,000 kilohm range	±0.005% of reading and ±0.0002% f.s.
Response time	
Step response	750 msec
With Range change	750 msec/range

GENERAL SPECIFICATIONS

Operating temperature range	-40° to +55°C (internal temp. remains above +15°C)
Maximum power requirement	50 watts, 105 to 125 V (export 210 to 250 V), 50 to 70 Hz (400 Hz special)
Maximum common mode voltage	250 volts
Dimensions	Standard 19-inch rack width; 5-1/4" high
Guarantee	12 months, faulty workmanship or component failure

SECTION 2

INSTALLATION & OPERATION

2.1 UNPACKING & INSPECTION

2.2. The Model 5524 Digital Voltmeter is crated in a plastic foam container consisting of two half-forms joined together and securely taped. The forms are contoured so as to hold the digital voltmeter firmly in place with the container absorbing any reasonable external shock. Before uncrating, examine the container for any sign of external damage. Then perform the following steps.

(a) Carefully cut the tape holding the two half-forms together and remove the digital voltmeter. Inspect the digital voltmeter for signs of damage. If damage is found, notify the carrier immediately.

(b) Remove the chassis from the sealed case by removing the eight screws on the front panel and pulling gently but firmly toward the front of the instrument. (It is not necessary to remove the chassis completely from the case. Slide it out far enough to expose the boards.) See that all boards are firmly seated in the connectors. Replace dessicant (see 2.9).

(c) Replace chassis and secure by tightening the eight panel screws.

2.3 POWER CONNECTION

2.4. An eight-foot, three-wire, coiled power cable is supplied with the instrument. This cord connects to a three-pin power connector (J203) at the rear of the unit.

2.5 INPUT CONNECTOR

2.6. J101 on the front panel is wired in parallel with J204 on the rear panel. These connectors are supplied with mating connectors only. No cables are supplied. Pin assignments of the input connector are listed below.

Table 2.1. Pin Assignments - Input Connectors

FUNCTION	PIN
+ Signal	N
- Signal	P
+ Ohms	R
- Ohms	S
Ref. Input (ratios)	T
Guard	Pins A thru M

2.7 REMOTE PROGRAM/DIGITAL OUTPUT CONNECTORS

2.8. For pin assignments and other information necessary for installation and operation of the optional Electrical Output and Remote Programming accessories, see Section 3.

2.9 DESSICANT

2.10. The dessicant consists of a moisture adsorption packet and a humidity indicator placed within the sealed case of the instrument. The packet should be replaced each time the sealed case is opened.

2.11. The packet is supplied in a heat-sealed outer bag. The sealed outer bag must not be punctured or opened until ready for use. When the outer bag is opened, the dot on the humidity indicator should be blue. If not blue, the adsorption packet is defective and another should be used. Once the sealed bag is opened, the adsorption packet must be installed and the instrument sealed within five minutes.

2.12. Additional adsorption packets may be obtained from:

Coast Engineering Laboratory
3755 Inglewood Avenue
Redondo Beach, California

Order by part number DEEC-1.

2.13 INITIAL CHECKOUT PROCEDURES

2.14. The following procedure is performed to verify that no damage has occurred during shipment and that the instrument is operative. Slight deviations in readings during the following tests may be corrected by making simple adjustments. For instructions refer to Section 5, "Calibration". Any major discrepancies should be reported to the carrier and to Dana Laboratories immediately.

2.15. Prior to performing the checkout procedure, it may be advisable to refer to the operating instructions beginning at 2.25.

2.16 ZERO CHECK

(a) Set FUNCTION control to MV and RANGE to 100.

(b) Short input leads. Visual readout should display 000.00.

(c) If necessary, adjust MV ZERO on front panel to obtain this reading.

2.17 POLARITY GAIN CHECK

(a) Set FUNCTION control to DC and RANGE to 10.

(b) Apply a known voltage of approximately -10 volts to the input. Visual readout should display value of input voltage (within specified tolerance and proper polarity.

2.18 RANGE CHECK

(a) Set RANGE to 100.

(b) Connect input to a source of +100 DC.

(c) Visual readout should display input value and proper polarity.

(d) Vary input voltage and polarity and check for proper readout (within specified tolerance).

(e) Repeat on 1000 volt range.

(f) Repeat the above steps with range on mV and using 100mV and 1000mV inputs.

2.19 AC CHECK

(a) Connect signal generator to input. Set FUNCTION switch to AC.

(b) Set generator to 50Hz and check for proper readout at the following input voltages: 9 volts, 90.0 volts, and 125 volts.

2.20 OHMS CHECK

(a) Measure standard resistors of values near full scale for each range.

(b) Check for proper readout (within specified tolerance) and ohms indication.

2.21 FUSES

2.22. On the rear panel are three fuses: F201, the power fuse; F202, the fan fuse; and F203, heater fuse (the 400 watt heater is operated by a thermostat within the instrument). Each fuse is wired to an indicator on the front panel that illuminates when the corresponding fuse is blown. The fuses are identified in table 2.2.

2.23 EXTERNAL CONNECTOR IDENTIFICATION

2.24. All external connectors are identified in table 2.3.

Table 2.2. Fuse Identification

Fuse	Function	Type
F201	Power	F02B 250V 1 Amp
F202	Fan	F02B 250V 1 Amp
F203	Heater	F02B 250V 5A

2.25 CONTROLS (See Figure 2.1)

2.26 POWER SWITCH

2.27. This is a two-position switch that applies power to the instrument. When Power is ON, the DVM display is always lit.

2.28 READ/HOLD SWITCH

2.29. This is a two-position switch that allows the operator a choice of a READ mode, in which new readings are commanded at a fixed rate of four per second, or a HOLD mode, which freezes

Table 2.3. External Connector Identification

Connector	Dana P/N	Mfr.	P/N
Signal Input J101	600359	Glass Seal	BE1H14-19P (Var B)
Mating Connector	600352	Cannon	KSP06F14-19S
Remote Program J201	600357	Glass Seal	BE7H16-26P
Mating Connector	600353	Cannon	KSP06F16-26S
Digital Output J202	600356	Glass Seal	BE7H22-55P
Mating Connector	600355	Cannon	KSP06F22-55S
Power J203	600360	Glass Seal	BE7H12-3P
Mating Connector	600354	Cannon	KSP06F12-3S
Signal Input J204	600358	Glass Seal	BE7H14-19P (Var A)
Mating Connector	600352	Cannon	KSP06F14-19S

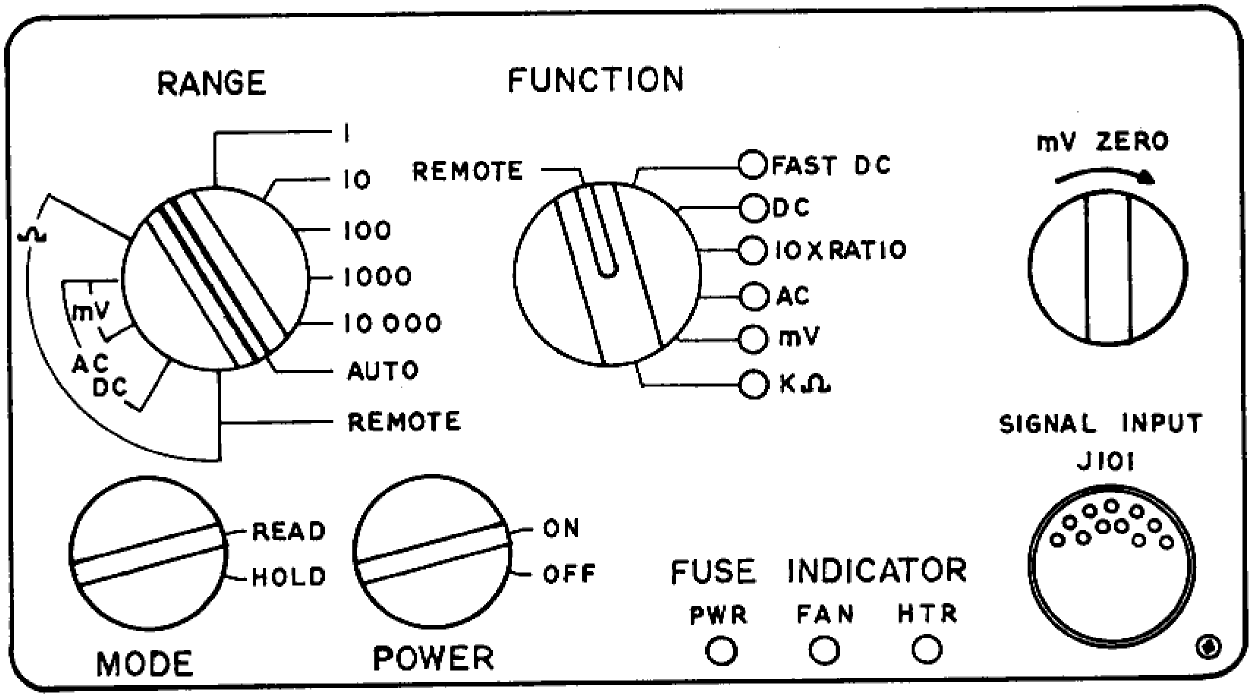


Figure 2.1. Control Panel

the last previous reading indefinitely. HOLD is released by turning the switch back to the READ position.

2.30 FUNCTION SWITCH

2.31. The FUNCTION switch is a seven-position switch having the following positions:

(a) REMOTE. In REMOTE, the selection of the function to be measured is made externally through the Remote Program input connector.

(b) FAST DC. This position selects high-speed, non-filtered DC measurements from 100uv to 1000 volts (plus overrange).

(c) DC. DC selects medium-speed dc measurements from 100uv to 1000 volts. An input filter is installed in the circuit in this position.

(d) 10X RATIO. This position selects the measurement of the ratio of the DC input voltage to a +DC reference voltage (+2 to +11 V.) both applied at the input connector.

(e) AC. This position selects the measurement of AC voltages from 100uv to 1000 V (rms) at 50Hz to 100kHz.

(f) MV. This position selects the measurement of low-level DC voltages from 1 microvolt to 1000 millivolts (plus overrange).

(g) K-OHM. This position selects the measurement of resistance from 0.1 ohm to 10 megohms.

2.32 RANGE SWITCH

2.33. The RANGE switch has five fixed

range positions, an AUTO position and REMOTE.

(a) Fixed Ranges. The five fixed ranges are 1, 10, 100, 1000, and 10,000. Inscriptions on the panel define the ranges which can be used with particular functions. AC, DC, and FAST DC measurements can be taken on the 10, 100, and 1000 volt ranges. Millivolts can be measured on the 100 and 1000 ranges. Resistance can be measured on all five ranges. If a range is selected that is invalid for the function being measured, the instrument advances to the 1000 range whether or not there is an input. For example, if 10000 range is selected in MV function, the range advances to 1000. When this happens, the decimal point on the readout is blank indicating incorrect data.

(b) AUTO (Automatic). In this position, range is automatically selected for all functions by internal circuits.

(c) REMOTE. In this position, the selection of range is made externally through the Remote Program input.

2.34 MANUAL OPERATION

2.35. Once the instrument has been connected to the power line and to the signal source in accordance with the instructions in 2.3 through 2.12, the operator can make all the required measurements by setting the front panel manual controls to the indicated positions. Remote program operation is covered in Section 3. The voltmeter displays the four-per-second readings in the READ mode. It is therefore normally most convenient to leave the READ/HOLD control on the READ position, using the HOLD position only for special applications, such as remote command operation. When switching from one type of measurement to another by turning the FUNCTION control, it is generally advisable to keep the RANGE switch on AUTO so as to avoid overloading the input circuitry.

CAUTION

Voltage exceeding 250 volts must not be applied between chassis ground and guard (input connector, pins A through M) or between guard and the low input terminal (pin P). Avoid introducing more than 500 volts into the instrument while the FUNCTION switch is on AC or more than 30 volts while the FUNCTION switch is on MV.

2.36 DC MEASUREMENTS, FAST, NORMAL, AND MILLIVOLT

2.37. (Pin assignments of the signal input connector are repeated in figure 2.2). Attach the high side of the signal source to pin N of the input connector (J101 or J204); and the low side to pin P. The guard is connected to the low side of the measurement point.

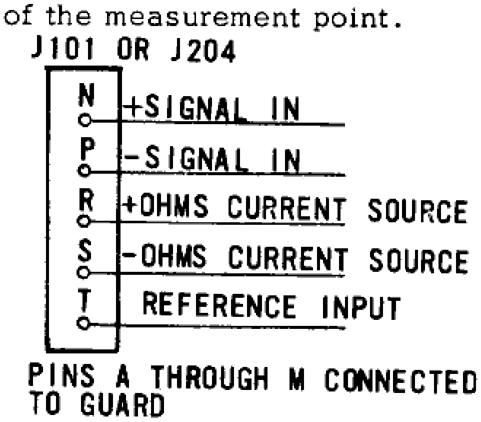
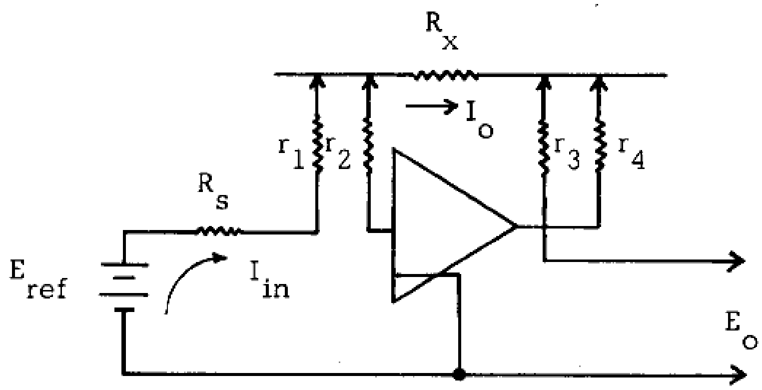


Figure 2.2. Input Connector

Table 2.4. Four-Wire Operational Ohmmeter



$$I_{in} = \frac{E_{ref}}{R_s}$$

(r_1 through r_4 = lead resistance)

Since $I_{in} = I_o$, $E_o = \dfrac{E_{ref}\ R_x}{R_s}$ and $\dfrac{E_o}{E_{ref}} = \dfrac{R_x}{R_s}$

<u>Analysis of Lead Resistance</u>

Lead resistances r_2 and r_3 have no effect since there is no current flow through them. Resistance r_4 is eliminated by being placed within the feedback loop. This is accomplished by proper placement of the voltage sensing lead (r_3).

Resistance r_1 affects the full scale current. Therefore, it causes a "percent of reading" error equal to:

$$\frac{R_1 \times 100}{R_s} \ \% \quad \text{where } R_s = \text{Standard Resistor}$$

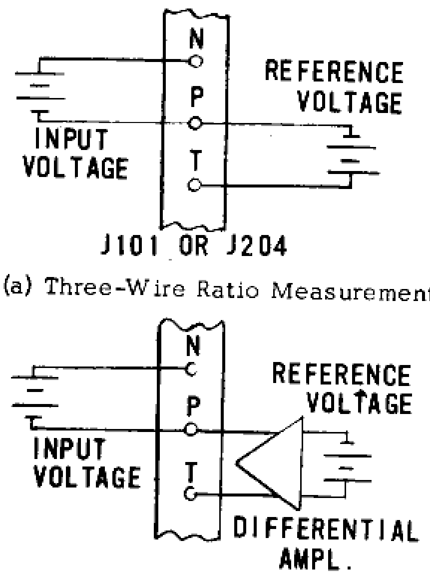
For example, if r_1 is 1 ohm and the standard resistor is 2K, the % of reading error is 0.05%.

It is important to note that r_1 has no effect at zero resistance and does not cause a % of full-scale error. For example, using the two-wire method, a lead resistance of 1 ohm creates an error of 1% when measuring 100 ohms (R_x).

If lead resistance is changed, a full scale adjustment must be made to maintain full accuracy.

2.38 AC MEASUREMENTS

2.39. Attach the high side of the signal source to pin N, the low side to pin P. Connect guard to low side of measurement point.



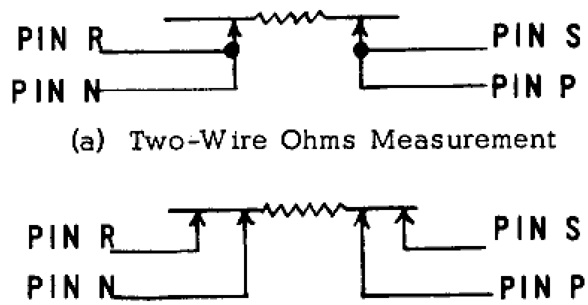
(a) Three-Wire Ratio Measurements

(b) Four-Wire Ratio Measurements

Figure 2.3. Ratio Measurements

2.40 RATIO MEASUREMENTS

2.41. Attach the signal input as for the DC instructions. Attach the +DC reference voltage with the positive side to pin T and the negative side to pin P. The instrument by itself makes three-wire ratio measurements since the signal and reference voltage have a joint common (see figure 2.3). For four-wire ratio measurements, an external differential amplifier (such as the Dana Model 2820) must be used. The amplifier can be placed in either the signal or reference input, depending on application.



(a) Two-Wire Ohms Measurement

(b) Four-Wire Ohms Measurement

Figure 2.4. Ohms Measurements

2.42 OHMS MEASUREMENTS

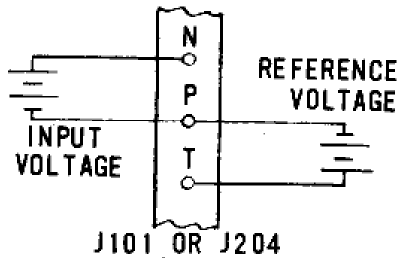
2.43. For two-wire ohms measurements, jumper pin R to pin N and pin S to pin P. The unknown resistance may be connected across either set of terminals.

2.44. For four-wire ohms measurements, separate sets of leads are connected to the non-jumpered signal input and ohmmeter-current source terminals. These leads are connected to the unknown resistance in the manner shown in figure 2.4.

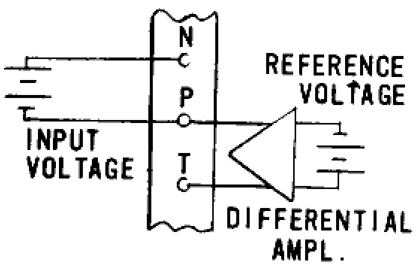
2.45. The four-wire configuration minimizes the effect of lead resistance. However, when this method of measurement is used, the full scale reading must be re-adjusted (by recalibration of the Ohms Converter with the cables to be used for measurement). No zero adjustment is required. See Table 2.4 for analysis of lead resistance.

2.38 AC MEASUREMENTS

2.39. Attach the high side of the signal source to pin N, the low side to pin P. Connect guard to low side of measurement point.



(a) Three-Wire Ratio Measurements



(b) Four-Wire Ratio Measurements

Figure 2.3. Ratio Measurements

2.40 RATIO MEASUREMENTS

2.41. Attach the signal input as for the DC instructions. Attach the +DC reference voltage with the positive side to pin T and the negative side to pin P. The instrument by itself makes three-wire ratio measurements since the signal and reference voltage have a joint common (see figure 2.3). For four-wire ratio measurements, an external differential amplifier (such as the Dana Model 2820) must be used. The amplifier can be placed in either the signal or reference input, depending on application.

(a) Two-Wire Ohms Measurement

(b) Four-Wire Ohms Measurement

Figure 2.4. Ohms Measurements

2.42 OHMS MEASUREMENTS

2.43. For two-wire ohms measurements, jumper pin R to pin N and pin S to pin P. The unknown resistance may be connected across either set of terminals.

2.44. For four-wire ohms measurements, separate sets of leads are connected to the non-jumpered signal input and ohmmeter-current source terminals. These leads are connected to the unknown resistance in the manner shown in figure 2.4.

2.45. The four-wire configuration minimizes the effect of lead resistance. However, when this method of measurement is used, the full scale reading must be re-adjusted (by recalibration of the Ohms Converter with the cables to be used for measurement). No zero adjustment is required. See Table 2.4 for analysis of lead resistance.

3.44. MV/DC RATIOS

3.45. The programming accessory enables the measurement of $\pm$MV/+DC and MV/DC ratios not possible with manual operation.

(a) Select desired range by applying a closure to common at the appropriate pin. Select ratio by applying common at pin G.

(b) Select the numerator of the ratio (MV) by a common to pin D. Wait 25 milliseconds and apply the input signal. No delay is necessary in application of the reference input. Apply a common to pin M, the Delayed Command — or provide a delay for settling time of the function and apply a common to the Direct Command input, pin P.

3.46. The instrument will now measure the ratio and display or print a number equal to ten times the ratio.

SECTION 3

DIGITAL OUTPUT AND REMOTE PROGRAM ACCESSORIES

3.1 INTRODUCTION AND OPTIONS

3.2. The isolated accessories available for use with the Dana Model 5524 Digital Voltmeter allow operation with non-isolated equipment with no loss in the common-mode characteristics of the voltmeter. This is achieved by the use of guarded reed relays between the instrument and all external input/output lines. The basic accessories and their identifying model numbers are listed below:

Isolated Electrical Output Model 76

Isolated Remote Program Model 77

Isolated Electrical Output/Isolated Remote Program Model 78

3.3. The isolated output can be adapted to the format requirements of a wide variety of printers and other digital output devices by use of a diode matrix which converts the internal digital voltmeter code to the desired BCD output. The more commonly used codes (1-2-4-8 and 1-2-2-4) have been standardized and assigned option numbers. Other BCD codes can be provided on special order.

3.4. Output voltage levels are produced by a switch closure to an externally supplied reference voltage. The user can, therefore, obtain the desired voltage levels by specifying either a switch-closure for a "false" bit or a switch-closure for a "true" bit. An open switch, of course, represents the complementary state. With contact-closure "true" specified, negative true outputs are obtained when a positive reference voltage is supplied; positive true outputs are obtained when a negative reference is supplied. With a contact-closure "false", the output sense is reversed.

3.5. The options described above are designated by a suffix to the basic accessory model number:

1-2-4-8 with switch-closure "true" is designated as D1.

1-2-4-8 with switch-closure "false" is designated as D2.

1-2-2-4 with switch-closure "true" is designated as E1.

1-2-2-4 with switch-closure "false" is designated as E2.

3.6. For example, a Model 5524 DVM having basic accessory Model 75 with 1-2-4-8 code, switch-closure "true" is identified as 5524-78-D1.

3.7. Physically, each basic accessory consists of a printed circuit "motherboard" containing nine connectors into which additional printed circuit boards are placed. The nine connectors are designated as J211 through J219. Four types of boards are used; the quantity of each is determined by the basic accessory model. The complement of each type board in each basic accessory is shown in table 3.1. Separate

Table 3.1. Board Types

Basic Accessory	Isolated Output Boards					Isolated Programming Boards		Range & Funct. Code Board	Com'd Logic Board	Delay Board
	J211	J212	J213	J214	J215	J216	J217	J218	J219	J220
Model 76	X	X	X	X	X		X	X	X	
Model 77					X	X	X		X	X
Model 78	X	X	X	X	X	X	X	X	X	X

sets of diode matrices are installed in the decade boards and in the output accessory to obtain the proper BCD output for the specified option.

3.8. The digital outputs of each accessory are delivered through connector J202; program inputs are made through J201. The connectors are mounted on the rear panel of the DVM (see Figure 3.1). Specific pin assignments of the connectors are listed on the pin assignments charts, Table 3.3 (page 3-6) and Table 3.6 (page 3-10).

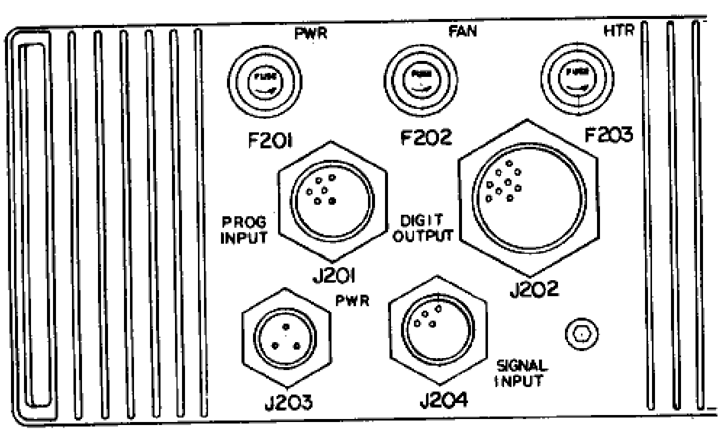


Figure 3.1. Rear Panel

3.9 ISOLATED OUTPUT BOARD (J211 through J215)

3.10. The Isolated Output circuit boards are used in basic accessories 76 and 78 only, since Model 77 does not deliver an electrical output. The boards contain guarded reed relays that provide isolation between the digital voltmeter circuits and the output device. They also contain diode matrices to convert polarity and overrange information into the desired BCD output format. The configuration of a typical output bit (X1) is shown in Figure 3.2.

3.11. When the X1 input from the DVM digitizing circuits is at digital common, relay K1 is energized. This places the X1 output at common. When K1 is not energized, the voltage at the X1 output is dependent on the external supply voltage. Relay K1 is energized on either the "true" or "false" DVM outputs depending on the option selected and determined by the diode matrix in the Decades of the digital voltmeter.

3.12 ISOLATED PROGRAMMING BOARD (J216 - J217)

3.13. The configuration of a typical Isolated Programming input circuit is

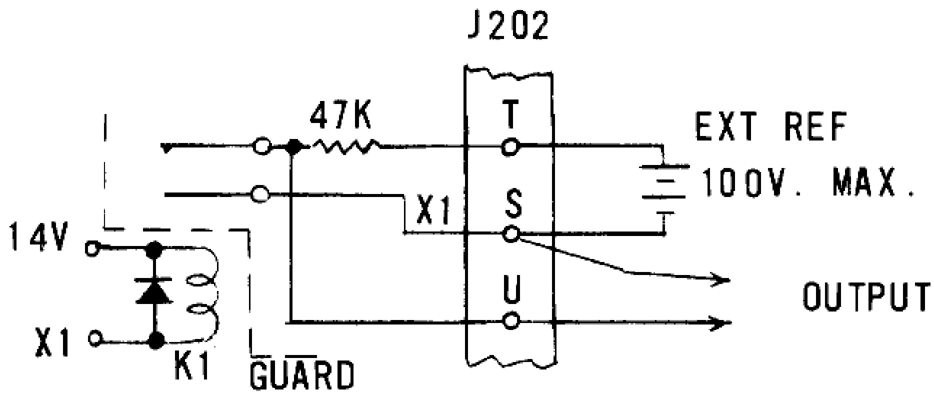


Figure 3.2. Typical Output Circuit

shown in Figure 3.3. Two boards are used in Models 77 and 78 one board (J217) is used in Model 76.

3.14. The command for a function or range selection is made by supplying a common to the appropriate pin on the Programming Input connector. One side of each programming relay is tied to one side of each of the other relays and to the external +12 volt supply supplied by user.

3.15. Current flow through a closed circuit is approximately 6 milliamperes.

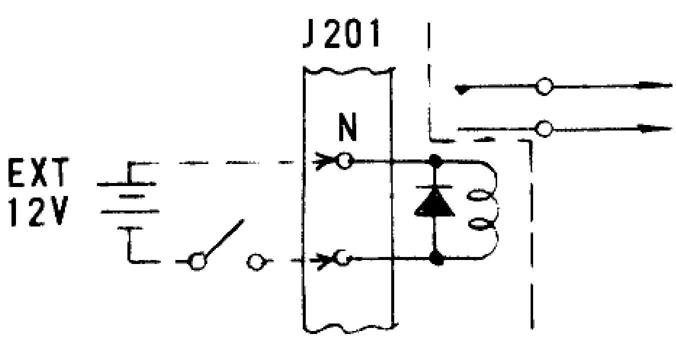


Figure 3.3. Typical Program Input

3.16 RANGE/FUNCTION CODE BOARD (J218)

3.17. The Range/Function Code board contains two diode matrices. One is used to convert the internal DVM function code to the selected output format; the other matrix converts the internal DVM range code to the selected output format. Specific coding differs with the option selected. The codes are identified on the "Pin Assignments" chart for the particular accessory.

3.18 COMMAND LOGIC BOARD (J219)

3.19. The Command Logic Board used in the Model 76 options, provides an approximate 1 ms delay for the print drive signal. The Command Logic Board used in the Models 77 and 78 options, is used in conjunction with the Delay Board (J220). These two boards, provide a delay or "timeout" period to provide settling time for the input accessories (used with AC, DC, Kilohms, or MV measurements) and to allow time for the DVM to change ranges when operating in Auto Range. At the end of the delay period, a Print Command is generated.

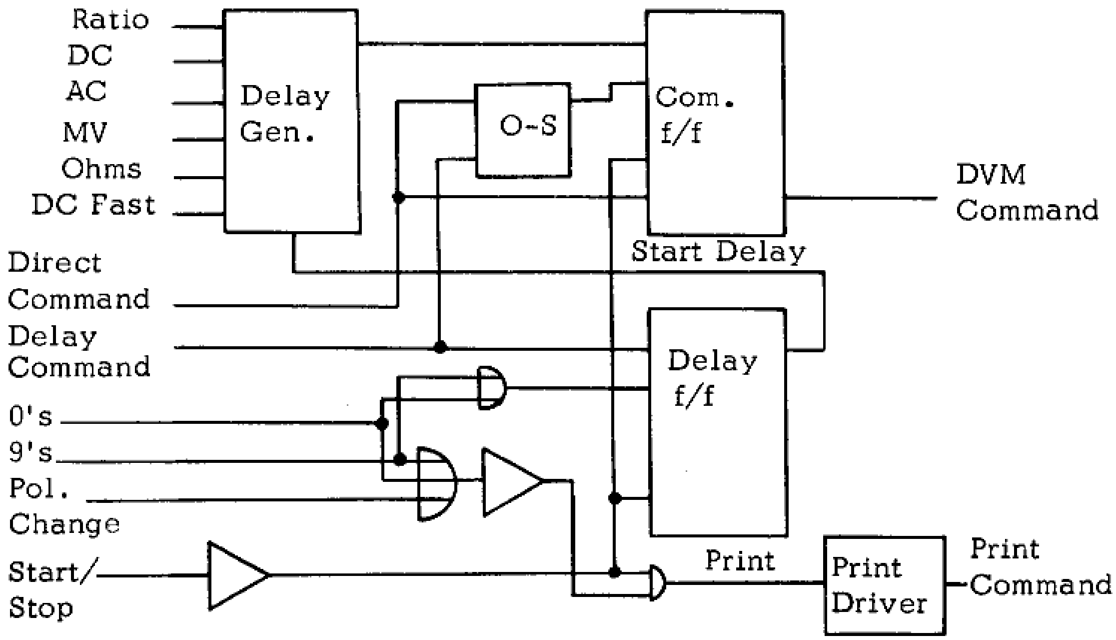


Figure 3.4. Block Diagram - Delay Circuit

3.20. A simplified diagram of the Command Logic and delay circuitry is shown in figure 3.4. This general configuration is used with Models 77 and 78. A simplified block diagram of the Print Command logic used in the Model 76 options is shown in figure 3.5.

3.21 DVM COMMAND

3.22. The DVM Command is applied to the instrument causing a new reading to be taken. The command is initiated on the negative-going edge of a positive pulse generated by the Command flip-flop. The flip-flop is set true by either the Direct Command or an inverted start stop strobe pulse generated at the end of a DVM read cycle. The flip-flop is reset by the delayed output of the one shot (initiated by either the direct or delay command) or the delayed pulse of the delay generator. The Delay Generator provides various timeouts to allow for the settling time of the accessory selected (see table 3.2). The delay determining portion of the circuit is located on the Delay Board. The Delay starts when the delay flip-flop is set true by the Delay Command or by the 0's and 9's signals from the decades indicating that either the up or down range change is required. The Delay flip-flop is then reset by the start-strobe.

Type of Measurement	Delay
DC Volts - Fast	105 ms
Ratio	630 ms
DC Volts	630 ms
AC Volts	460 ms
Millivolts	1.25 sec
Ohms	890 ms

Table 3.2. Delay Times

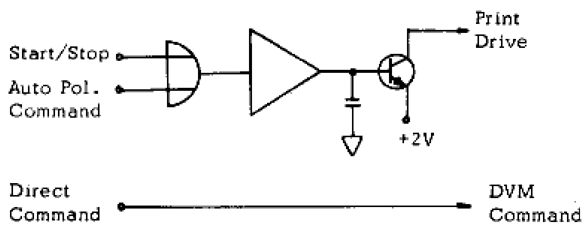
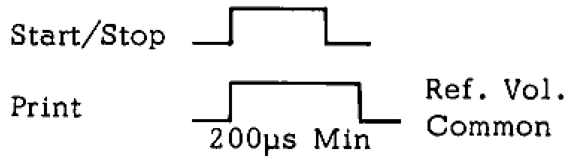


Figure 3.5. Print Command Logic



PRINT Command is a contact closure at the completion of the read cycle. The contact is open during the read cycle.

Figure 3.6. Print Command

3.23. The Print signal indicates that the instrument has completed the read cycle. The Print is taken from the inverted start-stop strobe signal and extended approximately 1 millisecond by the Print Drive circuit on the Delay Board. The Print signal is inhibited during a range and polarity change.

3.24 DIGITAL OUTPUT CONNECTIONS

3.25. Pin assignments of the Digital Output connector, J202, are given in Table 3.3. The outputs include data from each decade (units through 100,000) range, polarity, and function. Each output consists of four bits, X1 through X4, representing 1-2-2-4 or 1-2-4-8 depending on the option. The BCD output format for each option is shown in Table 3.4. The table also includes sample data outputs. Outputs are obtained by supplying an external reference voltage as described below.

3.26 EXTERNAL VOLTAGE SUPPLY

3.27. The external reference supply of up to 100 volts is applied across pins T and S of J202. This voltage is present at each individual output pin when the corresponding relay contacts are open (Figure 3.2). This will occur on either a true or false bit, depending on the option selected.

3.28. The common sides of each pair of relay contacts are normally tied together. However, the commons for each group can be brought out separately (as explained in 3.33) if so desired.

3.29. Polarity bits X2, X3, and X4 are either permanently strapped to common or tied (through 47K ohm resistors) to the reference voltage, depending on option.

3.30 PRINT COMMAND

3.31. The Print Command, J201-pin U, indicates to the printer that the data present at the output connector is final data (the measurement cycle has been completed) and that it is time to print. During the measurement cycle, the printer is inhibited from printing the interim data values by a voltage level on this line. At the end of the measurement cycle, the level changes providing the print command (Figure 3.6). The signal can be of either polarity. The voltage is the external reference voltage in series with 47K resistor.

3.32. The external reference voltage and the print command appear at both

Table 3.3
Digital Output
Connector J202

Function		Pins		Function	
Range	X1	HH	FF	Range	X3
Range	X2	GG	EE	Range	X4
Polarity	X1	CC	AA	Polarity	X3
Polarity	X2	BB	z	Polarity	X4
Units	X1	y	w	Units	X3
Units	X2	x	v	Units	X4
10's	X1	u	s	10's	X3
10's	X2	t	r	10's	X4
100's	X1	q	n	100's	X3
100's	X2	p	m	100's	X4
1000's	X1	k	i	1000's	X3
1000's	X2	j	h	1000's	X4
10K's	X1	g	e	10K's	X3
10K's	X2	f	d	10K's	X4
100K's	X1	c	a	100K's	X3
100K's	X2	b	Z	100K's	X4
Function	X1	Y	W	Function	X3
Function	X2	X	V	Function	X4
Print Command	(1)	U	G	Function Common (2)	
Ext. Reference	(1)	T	H	Range Common (2)	
Common	(1)	S	N	Polarity Common (2)	
			M	Units Common (2)	
			R	10's Common (2)	
			K	100's Common (2)	
			P	1000's Common (2)	
			L	10K's Common (2)	
			J	100K's Common (2)	

(1) Model 77 equipped with these lines only

(2) See paragraph 3.33

Mating Connector:
Dana P/N 600356 - Glass Seal P/N BE7H22-55P

D1 - D2 OPTIONS																
BCD 1-2-4-8	D1 Switch Closure = True (1) D2 Switch Closure = False (0)															
J202 Pin No.	HH	GG	FF	EE	Y	X	W	V	CC	BB	AA	z				
Range 1	0	0	1	0												
Range 10	1	1	0	0												
Range 100	0	1	0	0												
Range 1000	1	0	0	0												
Range 10000	0	0	0	0												
DC					1	0	0	0								
Ratio					0	1	0	0								
DC Fast					1	1	0	0								
AC					0	0	1	0								
MV					1	0	1	0								
Kilohms					0	1	1	0								
+ Polarity									0	0	0	0				
- Polarity									1	0	0	0				
Code	1	2	4	8	1	2	4	8	1	2	4	8				

TRUTH TABLE								
	D Options				E Options			
DEC.	1	2	4	8	1	2	2	4
0	0	0	0	0	0	0	0	0
1	1	0	0	0	1	0	0	0
2	0	1	0	0	0	1	0	0
3	1	1	0	0	1	1	0	0
4	0	0	1	0	0	1	1	0
5	1	0	1	0	1	1	1	0
6	0	1	1	0	0	0	1	1
7	1	1	1	0	1	0	1	1
8	0	0	0	1	0	1	1	1
9	1	0	0	1	1	1	1	1

E1 - E2 OPTIONS																
BCD 1-2-2-4	E1 Switch Closure = True (1) E2 Switch Closure = False (0)															
J202 Pin No.	HH	GG	FF	EE	Y	X	W	V	CC	BB	AA	z				
Range 1	0	1	1	0												
Range 10	1	1	0	0												
Range 100	0	1	0	0												
Range 1000	1	0	0	0												
Range 10000	0	0	0	0												
DC					1	0	0	0								
Ratio					0	1	0	0								
DC Fast					1	1	0	0								
AC					0	1	1	0								
MV					1	1	1	0								
Kilohms					0	0	1	1								
+ Polarity									0	0	0	0				
- Polarity									1	0	0	0				
Code	1	2	2	4	1	2	2	4	1	2	2	4				

D1 - D2 OPTIONS - SAMPLE DATA VALUES																								
	100,000				10,000				1,000				100				10				UNITS			
J202 Pin No.	c	b	a	Z	g	f	e	d	k	j	i	h	q	p	n	m	u	t	s	r	y	x	w	v
Decimal 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
000001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
000007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0
000014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0
000101	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
001246	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0
010999	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	1	0	0	1	1	0	0	1
104655	1	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	1	0	1	0	1	0	1	0
Code	1	2	4	8	1	2	4	8	1	2	4	8	1	2	4	8	1	2	4	8	1	2	4	8

E1 - E2 OPTIONS - SAMPLE DATA VALUES																			
	100,000				10,000				1,000				100				10		
J202 Pin No.	c	b	a	Z	g	f	e	d	k	j	i	h	q	p	n	m	u	t	s
Decimal 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
000001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
000007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
000014	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
000101	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
001246	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	1	1
010999	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	1	1	1	1
104655	1	0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	1	1	1
Code	1	2	2	4	1	2	2	4	1	2	2	4	1	2	2	4	1	2	2

Table 3.4. Output Codes and Format

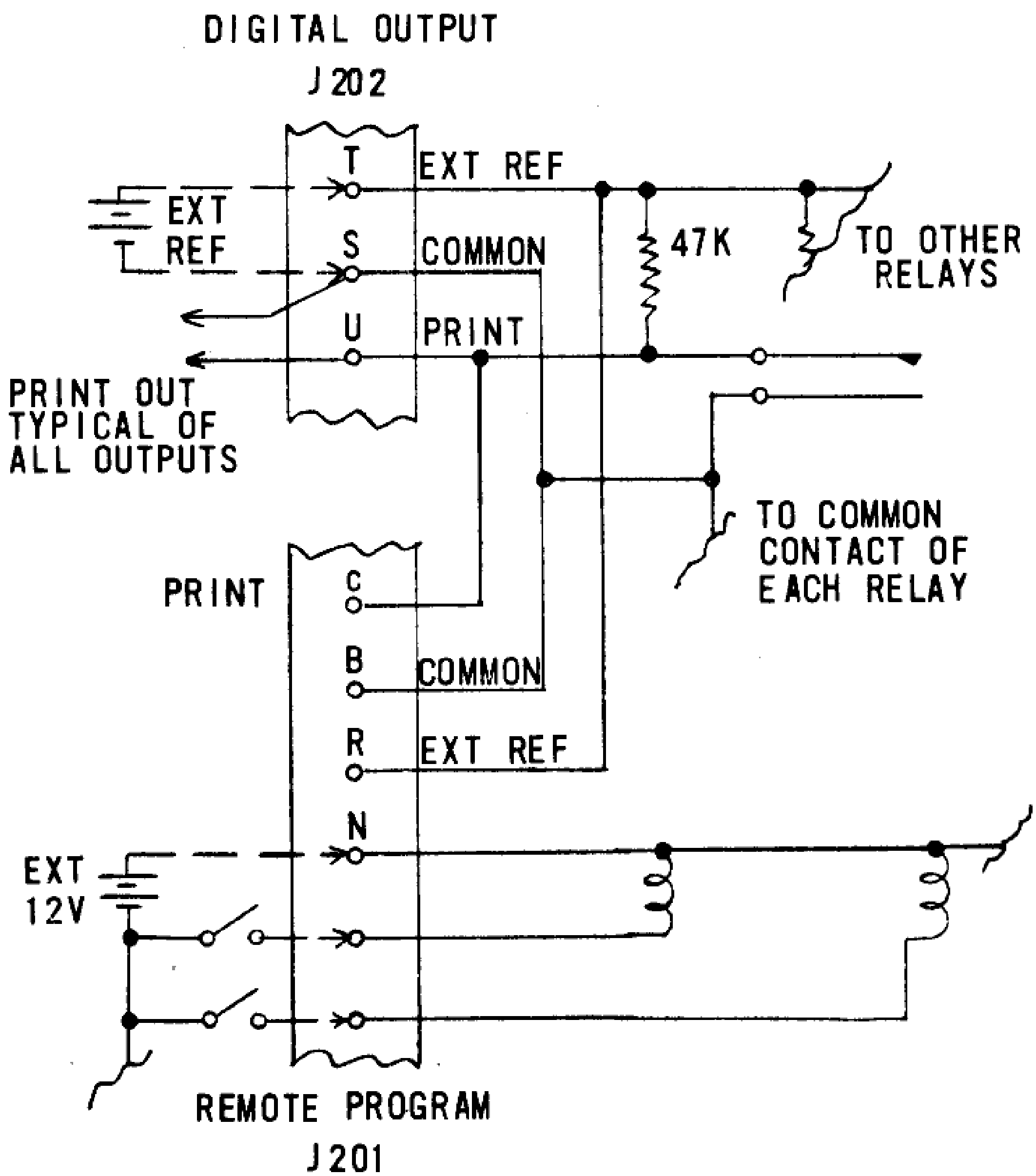


Figure 3.7. Output/Program Interconnections

the Digital Output connector and the Program Input connector (figure 3.7). Therefore, these external connections can be made at either of the two connectors.

3.33 DIGITAL OUTPUT COMMONS

3.34. As shown on the basic schematic of the Digital Output circuits, the commons for each group of outputs are tied together. If it is desired to isolate any or all groups of outputs, it is necessary to move the factory-installed jumpers to the appropriate pins. The terminals at which the jumpers are installed are physically located on the "mother board" and are identified on the intraconnection drawing (430699). The jumper terminals are listed in Table 3.5. To isolate any output, remove the factory-installed jumper at the terminals listed in column 3 and install jumpers at the terminals listed in column 4.

3.35 REMOTE PROGRAM OPERATION

3.36. With the Remote Program accessory, the instrument can be operated by remote contact closures or by a combination of front-panel manual controls and remote contact closures.

3.37. Table 3.6 provides a list of pin assignments of the instructions that may be programmed at J201, the Remote Program connector. In order to operate the isolated relays, it is necessary to connect an external +12 volts to pin N of J201 (see Figure 3.7). An instruction is transmitted into the instrument by providing a common (to the externally supplied +12 volts) at the pin corresponding to the desired command (identified in Table 3.6). The instruction is not operative, however, unless the corresponding manual control on the

Table 3.5. Common Jumpers

(1) J202 Pin	(2) Function	(3) Jumpers Installed	(4) Jumpers for Isolation
G	Function Common	E2 - E10	E10 - E20
L	10,000's Common	E8 - E11	E11 - E19
P	1000's Common	E9 - E12	E12 - E23
K	100's Common	E7 - E13	E13 - E24
R	10's Common	E5 - E14	E14 - E25
N	Polarity Common	E4 - E16	E16 - E27
M	Units Common	E3 - E15	E15 - E26
H	Range Common	E1 - E18	E18 - E21
J	100,000's Common	E6 - E17	E17 - E22

front panel is set to its REMOTE position. Therefore, to remotely program the range, the RANGE control must be set to REMOTE. The same is true of the FUNCTION control, if the function is to be remotely programmed. It is possible, however, to set one control manually while another is being remotely controlled.

Table 3.6
Remote Program
Connector J201

Function	Pin
1 Range	Y
10 Range	W
100 Range	L
1000 Range	K
10K Range	J
Ratio	G
DC Fast	H
DC	V
AC	X
MV	D
Kilohms	F
Hold(1)	U
Command(1)	P
Delayed Command	M
Ext. Reference	R
Common	B
Print	c
+12 Volts(1)	N

(1) Model 76 equipped with these lines only

Mating Connector:
Dana P/N 600356
Glass Seal P/N BE7H22-55P

3.38. Each Accessory includes a pin for commanding the instrument to take a reading. To enable this command function, the instrument is put in the Hold mode, either by turning the front panel READ-HOLD control to the HOLD position or by providing a command (common) to pin U (Hold). A single reading can then be commanded by a common to pin P (command). The instrument immediately initiates a measurement cycle, and holds this measurement until the common at pin P is broken and again made.

3.39. The delays listed in table 3.2 are obtained by applying a common to pin M, the Delayed Command, rather than pin P which provides no internal delay.

3.40 GENERAL PROGRAMMING RULES

(a) Commands (contact closures) must be 3 milliseconds (min.) duration.

(b) The range and function relays require approximately 25 milliseconds to switch. Therefore, after the function and range selections are made, 25 milliseconds should be allowed before application of the input signal.

(c) If the Read Command is made at the Direct Command input (pin P) rather than the Delayed Command input (pin M), a delay equal to that in Table 3.7 must be provided if the range, function, or input signal have been changed.

Table 3.7. Settling Time

Function	Settling Time
DC Volts Fast	50 milliseconds
Ratio	500 milliseconds
DC Volts	500 milliseconds
AC Volts	300 milliseconds
Millivolts	1 sec
Ohms	750 milliseconds

These are settling times only. Table 3.2 lists the automatic timeout periods taken when using the delayed command. Times in Table 3.2 include settling time plus tolerances of components.

(d) If no remote range selection is made and the Range switch on front panel is on REMOTE, the instrument is in Auto Range.

(e) With the instrument on Auto Range and the Direct Command input used, the Command (closures) must not exceed 25 milliseconds.

3.41 GENERAL PROGRAMMING PROCEDURE

3.42. The following procedures assume that the connections to the measurement points are made as described in 2.34 through 2.45.

(a) Place instrument into HOLD mode either by setting the front panel MODE switch to HOLD or by applying a closure to common at pin U of J201.

(b) Apply closures to common at the pins corresponding to the desired function and range. For example, AC volts on the 100-volt range is commanded by closures to common at pins X and L. If Auto Range is desired, do not select any range.

CAUTION: If the selected function was changed from the previous measurement, the input voltage should not be applied for 25 milliseconds. If the previous measurement was, for example, MV, 100 volts AC may damage the input circuits if applied before the relays are completely switched.

(c) If function was changed, allow 25 milliseconds for relay operation, then apply input signal. Command a Delayed Read by completing a closure to pin M. If the command is made at the direct Command input (Pin P), the Read must be delayed by the settling time of the function being measured (see Table 3.7). At the end of the measurement cycle, the print line, pin c, drops to zero and the instrument will accept another command.

3.43. When used in a system such as a scanner where the inputs are the same function, it may be more convenient to select the function and range manually and use only the Print and Read Command lines remotely. Upon receipt of the Print Command, the external system itself may generate the next Read Command.

divider network consisting of a fixed resistor, a potentiometer, and a Zener diode. The drive current for the Zener comes from the output of the Reference Buffer itself. Through careful selection of components and a balancing of the various resistances in the feedback network, an essentially zero temperature coefficient is achieved within the operating range of the instrument.

4.90 DISPLAY (Schematic 430389)

4.91. The Display board provides a mechanical assembly for the digital display tubes and carries the drive circuits for the neons that indicate decimal point, polarity, and range.

SECTION 4

THEORY OF OPERATION

4.1 INTRODUCTION

4.2. Circuits in the Model 5524 fall into two functional areas. The circuit boards in the right-hand side of the instrument as viewed from the front (J12-J22) are the signal conditioning circuits. The boards in the opposite side (J1-J11) are digitizing and display circuits. The purpose of the signal conditioning section is to provide a -10 volt full scale analog signal to the digitizing and display section where it is balanced against a current derived from a precise reference voltage.

4.3. This section describes, first, the signal conditioning circuits individually followed by a discussion of operation of the signal conditioning circuits for each mode (type of measurement). Overall operation of the digitizing and display section is then described since it is the same in all operating modes. This is followed by a description of individual circuits in that section.

4.4. The last two figures in this section are functional intraconnection diagrams of the signal conditioning section (Figure 4.10) and the digitizing and display section (Figure 4.11). Each of the diagrams can be unfolded allowing the diagram to be referenced while reading the circuit descriptions throughout the section. The diagrams are intended to supplement the complete schematics included in Section 6. Dana logic symbols are defined in Figure 4.1

4.5 SIGNAL CONDITIONING CIRCUITS

4.6 CONTROL AND ATTENUATOR (Schematic 430705)

4.7. The Control and Attenuator is the first assembly behind the front panel. On it are mounted the front panel switches and input/output terminals. The board contains relays that switch the function and range displays; filters; scaling resistors; and a feedback attenuator for millivolt measurements. The relays are controlled by the function selection -- from either the front panel switch or through remote programming -- and by the range signals -- from either the RANGE switch, through remote programming, or from the Range Control board.

4.8. Eight relays, K1 through K8, are used. One side of each relay coil is tied to +28V; the relay is energized by applying a digital common level to the opposite side. The purpose of each relay is indicated in the following table.

Relay	Energized By	Purpose
K1	AC Selected	Switches high side of input directly to AC Converter; switches filter into the circuit.
K2	R1 and R2 or Kilohms Selected	Range Switching
K3	MV Selected	Switches passive filter into circuit; adds feedback loop to Isolator and adds resistance network to common.
K4	R1 and R2 and Kilohm Selected or AC Selected	Range Switching
K5	AC Selected	Switches Auto Polarity Output to AC Filter
K6	Kilohm, Ratio, or DC Selected	Switches active filter into input circuit when "fast" function not selected.
K7	Kilohms Selected	Routes "current source" directly from Ohms Converter
K8	Kilohm Selected	Prevents leakage of current source through relay interconnections.

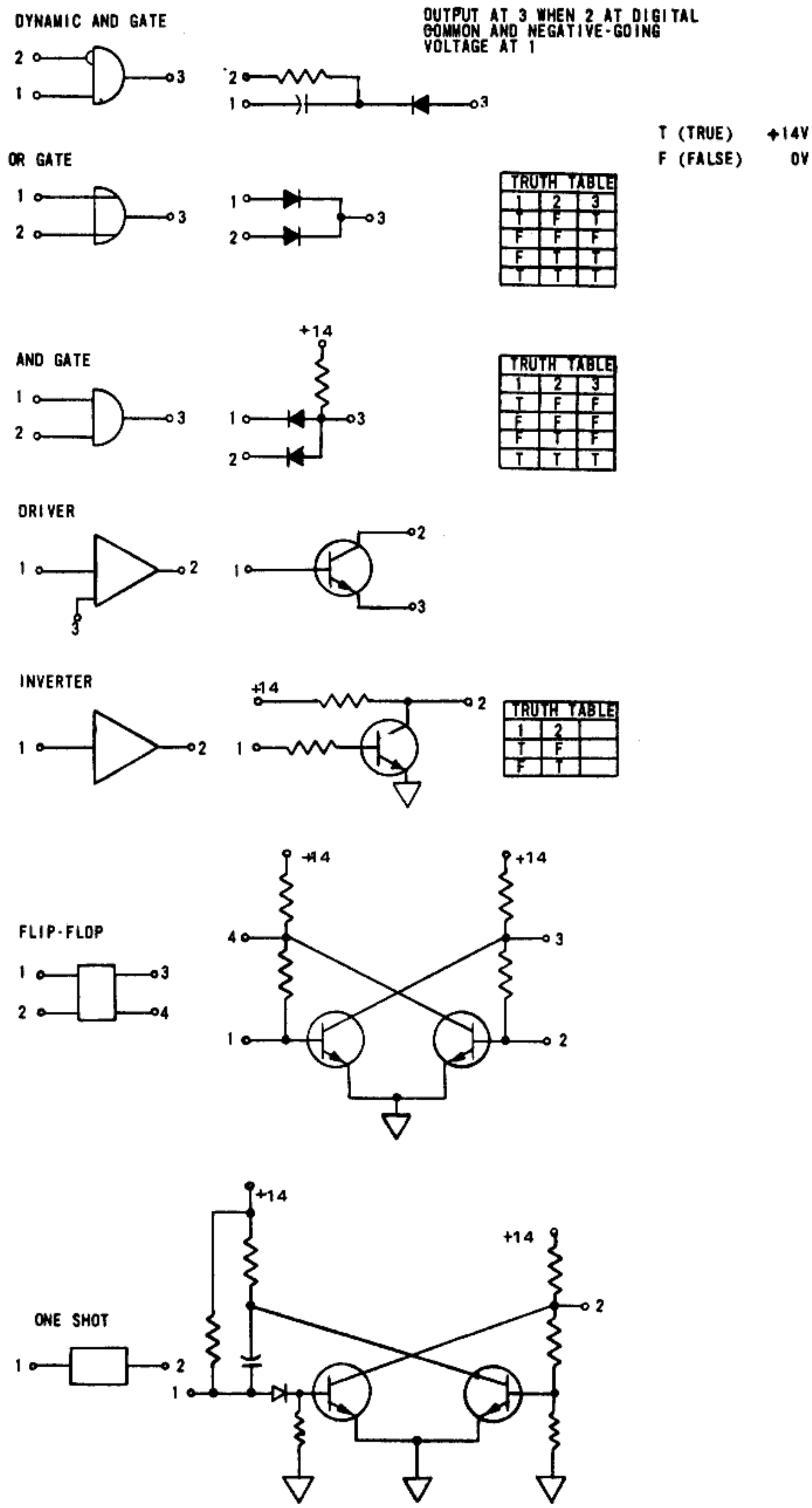


Figure 4.1. Dana Logic Symbols

4.9 ISOLATOR (Schematic 430659)

4.10. The Isolator is a floating-input potentiometric amplifier capable of operating at very low signal levels. The feedback loop, that establishes amplifier gain, is located on the Control and Attenuator board. The feedback circuit and the amplifier input are switched into various configurations to conform to the function selected. The amplifier operates as a unity-gain isolator for DC, ratios, and resistance measurements, as a gain of 10 amplifier for AC measurements; and as a preamplifier for millivolt measurements on the 100 and 1000 ranges.

4.11. Operating in conjunction with the Isolator amplifier is a "bootstrap" amplifier (consisting of Q1, Q3, Q4, Q7, Q8, Q9, and Q11, see schematic). This amplifier samples the voltage at the negative feedback point and adjusts the supply voltages to the input stage so that base and collector voltage remain constant. Also it provides a reference level for the first stage base current compensation network.

4.12 RANGE CONTROL (Schematic 430408)

4.13. Range changes in the instrument are determined by the BCD state of the Decades in the Digitizing and Display Module and controlled by the range signals R1, R2, R3, and their complements. These signals are the outputs of a three-stage counter on the Range Control circuit board. The counter counts up or down in response to logic at the input which depends on the function selected. If the decades are not at full scale (109999), the Count Up signal is inhibited by the lines from the Decades. If the state of the decades is not at one-tenth scale or less (010000), the Count Down signal is inhibited. The circuit arrangement of the inhibit lines is shown in Figure 4.2.

4.14. The Count Up and Count Down lines are clamped by diode gates on the decades when a change (either up or down) in the range counter is to be inhibited. An "up" range is allowed only when the Overflow flip-flop on the Control Logic board is set and the four lower-order decades are at nine—indicating 109999. In addition to this count, an "up" from the Trigger flip-flop is also required. At any count other than 109999, the Count Up signal is clamped to common by one or more of the diodes in the 0's or 9's gates on the Decade boards or diodes on the Overflow flip-flop output.

4.15. A "down" range is allowed only when the count is less than 01000. This is indicated by the Overflow flip-flop "off" and the 0's gate from the 10K decade "true". At other counts, the Count Down range signal is inhibited.

4.16. The count lines are also inhibited (clamped to common) by diodes on the Auto Polarity board during a polarity change.

4.17. The Count Up Range and Count Down Range signals have no effect on the counter except when the output of the Start/Stop Memory (S/S) one-shot is "true". This occurs when the S/S signal (generated in the Digitizing and Display module) goes "false" at the end of a digitizing process. The count signals can be inhibited also by the "forbidden range" logic explained in the following paragraphs. Normally the counter will count up as shown in the following table.

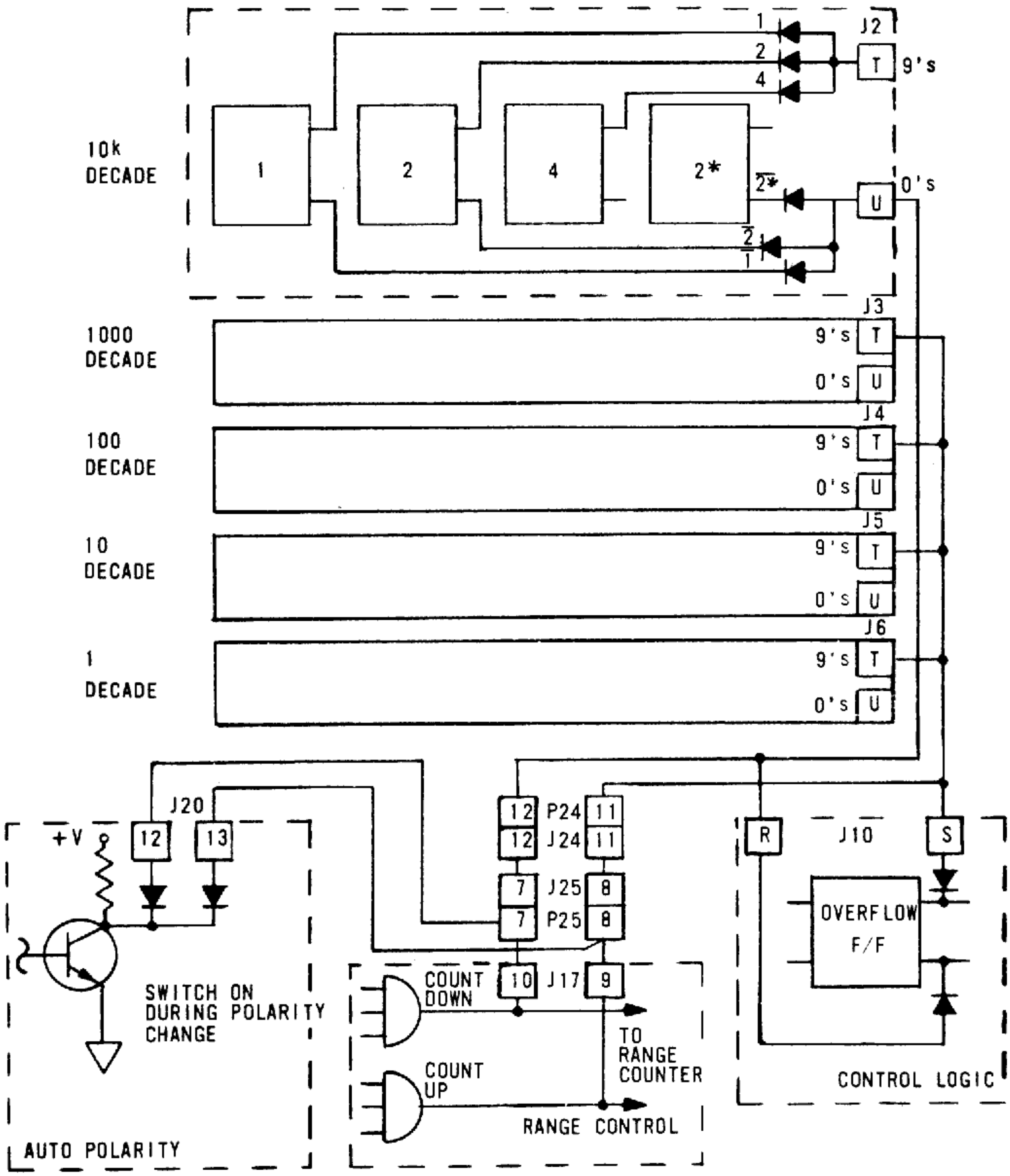


Figure 4.2. Range Counter Inhibit Lines

States			Range
R1	R2	R3	
0	0	0	1
1	0	0	10
0	1	0	100
1	1	0	1000
0	0	1	10,000

4.18. Since all ranges are not used for all functions, logic is present to prevent the counter from remaining on a prohibited range for a particular function. For example, with the Millivolt function selected, R2 is not allowed to reset and R3 is held "off" by the MV line applied to R2 and R3 through diodes CR37 and CR38. This allows only the 100 and 1000 ranges to be available with this function selected. Similarly, with the counter at 110 representing the 1000 range, a count-up pulse is inhibited unless the Kilohm function is selected—since that is the only function using the 10,000 range. The input line labeled Z is "false" when either AC, DC, DCF, or Ratio is selected. This line prevents the R3 flip-flop from setting—thereby skipping the 10,000 range.

4.19. Any fixed range, selected either manually or remotely, inhibits the automatic range function. This is done by logic gate "A" (Figure 4.10).

4.20 AUTO POLARITY (Schematic 430406)

4.21. The Auto Polarity board eliminates the need for polarity switching by maintaining, in conjunction with the Isolator output, a negative input to the Null Detector (in the digitizing and display section) regardless of the polarity of the input. The circuit consists of an inverting amplifier with polarity-dependent feedback paths, a differential amplifier, a polarity flip-flop, a one-shot circuit, and a relay driver.

4.22. The Isolator output is applied to the Auto Polarity board at pins D and 14. The signal is scaled to 10 volts full scale and of the same polarity as the input. When the input is negative, relay K1 is not energized and the signal (at pin 14) is routed directly to the Null Detector.

4.23. The Auto Polarity amplifier has a separate feedback path for each polarity. When the input signal is positive, the Auto Polarity amplifier output is negative. The output from the negative feedback path is routed to pin J of J20, through relay contacts on the AC Converter board and back to pin 1 of J20 and through a potentiometer, the + Polarity Gain adjustment, to the normally open contact of K1.

4.42. The negative voltage at the Auto Polarity output (at the junction of the two feedback diodes) and analog common form the input to a differential amplifier. The outputs of the differential amplifier enable the "dynamic and" gates at the polarity flip-flop input when at zero voltage. In this case (input signal positive), the gate at the reset input (2) of the flip-flop is enabled (the gate at 1 is approximately 10 volts).

4.25. Start-Stop is a signal from the digitizing and display section which is true (+14 volts) during the digitizing (measuring) time of the DVM. At the end of the measurement time, the line drops to zero and triggers the reset side (2) of the polarity flip-flop. The flip-flop outputs are now false (0 V) at 3 and true (+14 V) at 4.

4.26. The positive voltage at 4 turns on the relay driver (Q15) which provides a common to K1 and energizes that relay. The output to the Null Detector is now taken from the negative feedback path of the Auto Polarity amplifier.

4.27. The effect of the circuit can be summarized as follows: if the input signal is negative full scale (-10 volts), the output of the Isolator is also -10 volts. Relay K1 is not energized and the negative voltage from the Isolator is routed directly to the Null Detector. If the input signal is positive full scale (+10 V) the Isolator output is also +10 volts, the Auto Polarity Output (on negative feedback leg) is -10 volts. The Polarity flip-flop causes relay K1 to be energized and the negative voltage from the Auto Polarity amplifier is applied to the Null Detector. Therefore, the output to the Null Detector is always negative regardless of the polarity of the input.

4.28. A one-shot at the Polarity flip-flop output is triggered each time the Polarity flip-flop changes state. The one-shot "times out" in 10 msec at which time the DVM command (to Control Logic in digitizing and display section) is generated. The 10 msec allows relay K1 time to switch completely before the next reading is taken after a polarity change. During the 10 msec delay period, transistor Q17 is turned on clamping the 0's and 9's lines to digital common and thereby preventing the instrument from up- or down-ranging (in Auto Range) during a polarity change.

4.29 AC CONVERTER (Schematic 430437)

4.30. The AC Converter is an accessory board that may be plugged into the designated position in the instrument at any time. No special wiring is required; however, recalibration is required. The Converter consists of an AC-coupled, wideband, low-level amplifier with one permanent feedback path for the low range and shunt networks that are switched into the circuit by reed relays for the other two ranges. The unit is an operational amplifier, with resistor-capacitor pairs at the input and on the feedback loop. The full-scale output on all ranges is approximately 3 volts rms for a 10-volt rms input signal.

4.31. The output is applied to the Auto Polarity Amplifier which, in AC mode, serves as a full wave rectifier. Relay K3 is energized when AC is selected. It reroutes signals from the Isolator and Auto Polarity boards to obtain the proper circuit configuration for the measurement of AC volts.

4.32 OHMS CONVERTER (Schematic 430714)

4.33. The Ohms Converter is an operational amplifier used to generate a precise current through the unknown resistance. The range resistors, connected to the +20 volt internal reference voltage, determine the current source (+ current) to the summing junction at the input of the amplifier (+ sense). An equal amount of current is supplied to the summing junction, through the unknown resistor, from the output of the amplifier (- current). Because the reference current is taken from the internal reference of the DVM itself, the voltage output of the operational amplifier is a direct voltage equivalent of the unknown resistor value. The value of the range resistors is selected such that the output of the Ohms Converter is read by the DVM directly in kilohms.

4.34 MEASUREMENT OF DC VOLTS AND RATIOS

4.35. The circuit configuration used for the measurement of DC volts is shown in Figure 4.3. An identical arrangement is used when the instrument is in the ratio-measuring mode. The difference in these two types of measurements lies in the counterbalancing reference used in the Digitizing and Display section. DC volts are measured against a fixed internal reference; ratios are measured against an external reference.

4.36. As explained previously, the purpose of the signal conditioning section is to produce a negative 10-volt full scale signal (-10.9999, including overrange) at the input of the digitizing and display section. The negative voltage is applied across a precision resistor to produce a current that is nulled by an opposite current derived from the reference voltage.

4.37. The first step is to scale the incoming DC signal to 10 volts full scale. The precision scaling resistors in the Control and Attenuator circuit divide the input voltage by 10 if the signal is between $\pm$10.999 and $\pm$109.999 volts, and by 100 if the signal is between $\pm$109.999 and $\pm$1000.0 volts. The 10-volt full scale input is then filtered to remove superimposed noise and fed into the input of the Isolator.

4.38. The Isolator is, in this mode, a unity gain amplifier. Its output is therefore identical in polarity and amplitude with the scaled input. The voltage is directed to the 10K summing resistor in the Null Detector through the contacts of K1. When the Isolator output is negative, relay K1 is not energized and the negative voltage from the Isolator is applied directly to the summing resistor. When the Isolator output is positive, the Auto Polarity output is negative, the Polarity flip-flop is triggered, and the relay is energized. The negative Auto Polarity output is then applied to the summing resistor, through the Positive Gain Adjustment.

4.39. The current into the Null Detector, then, has two potential sources. If the input signal is negative, the Isolator output is negative and all of the required negative voltage is from the Isolator. On the other hand, if the input signal is positive, the Isolator output is positive, relay K1 is energized, and the negative voltage is taken from the Auto Polarity output.

4.40. The Auto Polarity amplifier derives its name from the fact that it allows the Null Detector to deal exclusively with negative currents from the signal conditioning section, without any delay for polarity switching. This is of particular importance when the signal is frequently passing through zero, as in the case of bridge balancing.

4.41. It is important to note that the Positive Polarity Gain adjustment is used to calibrate positive input voltages; however, the actual polarity of the voltage affected by this adjustment is always negative.

4.42 MEASUREMENT OF FAST DC VOLTS

4.43. When Fast DC measurements are being made, the configuration of the signal conditioning circuits is the same as for DC measurements except that the active filter is removed. Elimination of the filter allows the instrument to settle to within 0.01% of the final reading in 50 milliseconds, after a step-function change in input level.

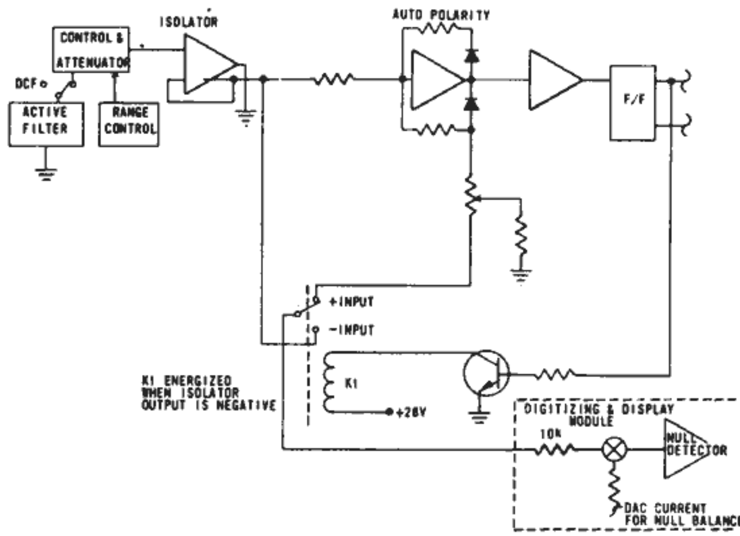


Figure 4.3. Block Diagram - DC and Ratio Modes

The filter slows the settling time down to 500 milliseconds. Other than this change at the input, the fast DC mode is identical to that of standard DC and ratio measurements.

4.44 MEASUREMENT OF MILLIVOLTS

4.45. The Signal Conditioning section "expands the scale" by switching the function of the Isolator circuit, changing it to a preamplifier. A 10-kilohm feedback loop is added to the amplifier. This, in conjunction with a resistance network to ground, switches the gain of the amplifier from unity to either 10 or 100. At a gain of 10, the instrument is operating at 1,000 millivolts full scale; at a gain of 100, full scale is 100 millivolts and the last digit resolution is 1 microvolt.

4.46. A passive filter is used at the input to attenuate superimposed noise. Otherwise the balance of the millivolt circuitry is identical to that used in measuring DC volts and ratios.

4.47 MEASUREMENT OF AC VOLTS

4.48. The measurement of AC volts involves the addition of the AC Converter amplifier and a major reorganization of the balance of the circuitry. Figure 4.4 illustrates this configuration.

4.49. The AC input signal is applied directly to the capacitor-coupled AC Converter amplifier. The principal purpose of this amplifier is to scale the input down so that the output of the stage is approximately 3 volts rms for a 10-volt rms, full-scale input signal. Input voltages in the 10-to-100 and 100-to-1,000 ranges are reduced by factors of 10 and 100, respectively.

4.50. The scaled-down voltage is applied to the Auto Polarity amplifier, which rectifies it and produces a negative voltage that is approximately $1/\pi$ of the input. A 10-volt rms full-scale input to the instrument is now reduced by exactly 1/10, to -1 volt. The half-wave rectified output of the Auto Polarity circuit is "summed" with the AC Converter output to produce a one-volt full-wave signal (the "weight" of the Auto Polarity output is twice that of the AC Converter and 180° out of phase with it).

4.51. The output of the Auto Polarity amplifier is filtered by an active filter on the Control and Attenuator Assembly

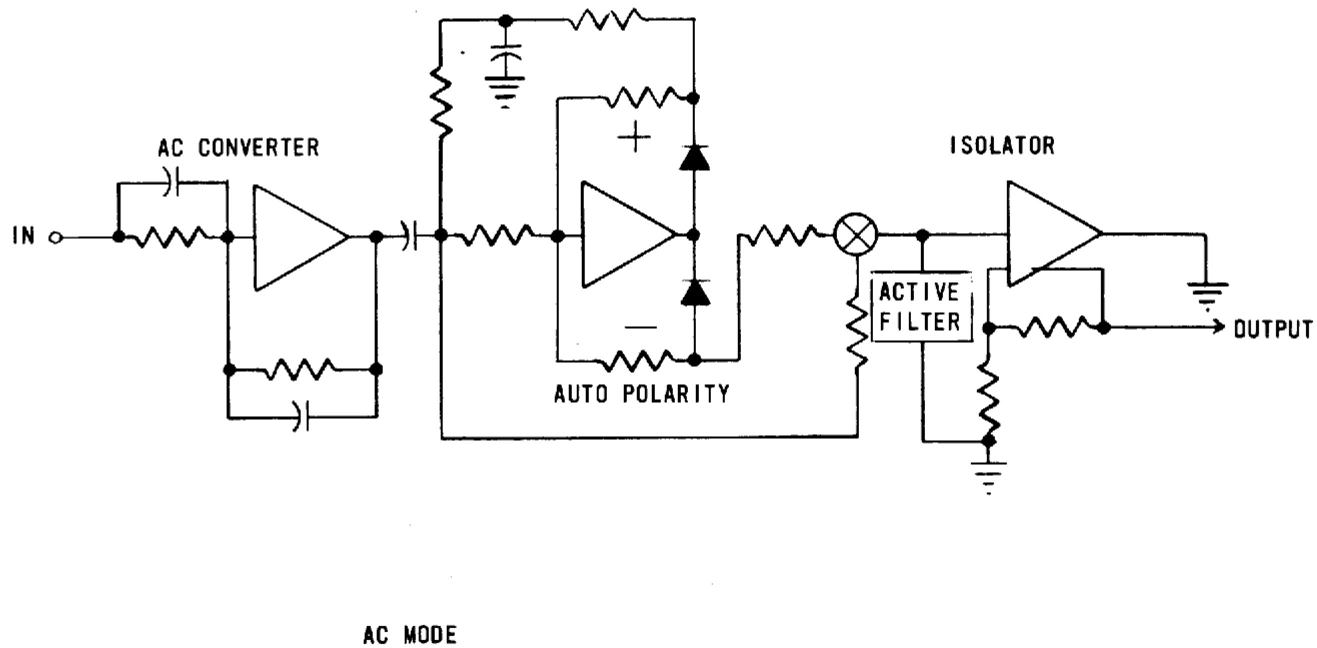


Figure 4.4. Block Diagram - AC Mode

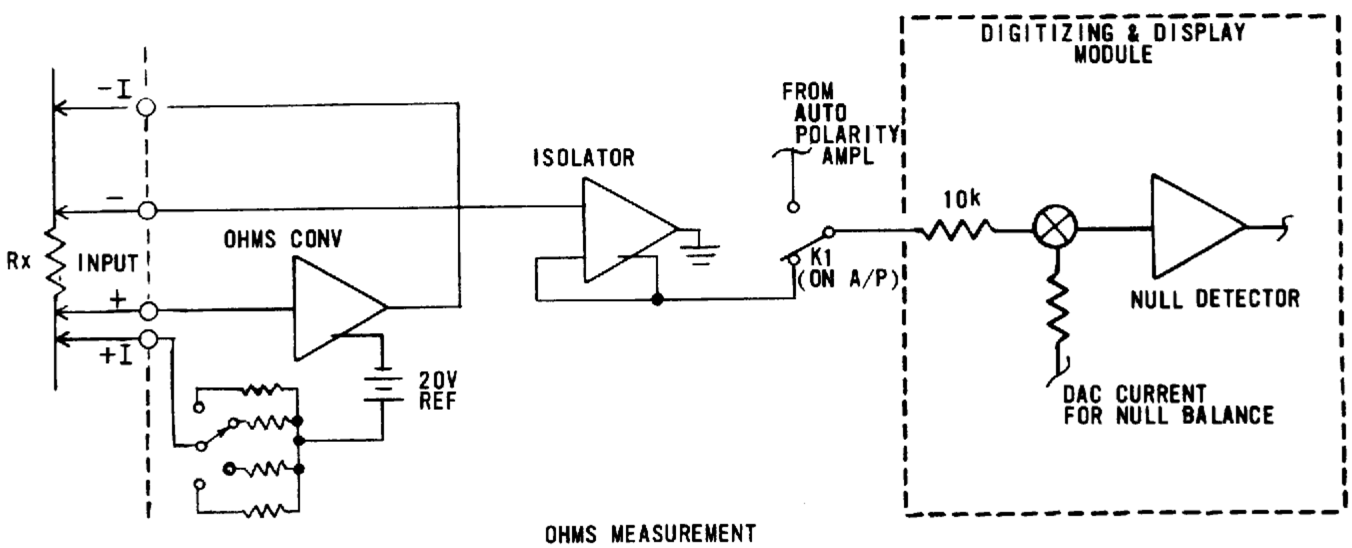


Figure 4.5. Block Diagram - Ohm Mode

board and then applied to the Isolator, which has been set to a gain of 10 (using the feedback resistors and attenuators that established the 1,000-millivolt range in the mV mode). The amplified negative voltage is, at this point, a 10-volt full-scale analog of the rms value of the AC input. It is fed directly to the current-determining 10 Kohm resistor at the input to the Null Detector.

4.52 MEASUREMENT OF OHMS

4.53. The ohms measurement configuration (Figure 4.5) of the Signal Conditioning section is similar to that used in the measurement of DC with the DVM held in negative polarity. The Ohms Converter provides a series of precise currents (a different current for each range) which is passed through the unknown resistor. The resultant voltage drop is read by the DC measuring circuitry as a negative voltage and displayed as Kilohms.

4.54 DIGITIZING AND DISPLAY CIRCUITS

4.55. A simplified drawing of the Digitizing and Display section is shown in Figure 4.6. The input from the Signal Conditioning circuits is applied to a summing junction at the input to the Null Detector. Regardless of the polarity of the voltage being measured, the current from the Signal Conditioning section is always -1 ma full scale. This current is combined with a positive current from the DAC (Digital/Analog Converter) circuit.

4.56. DAC current supplied to the summing junction is the analog equivalent of the digital value represented by the state of the Decade flip-flops. When the summing junction is brought to null, the state of the flip-flops indicates the exact digital value of the input signal.

4.57. The digitizing process, or "conversion", begins when the Start/Stop flip-flop (on the Control Logic board) is set. Start/Stop is set by either of two conditions. The Display Rate circuit turns it on automatically every 250 milliseconds unless inhibited by a ground level at the Ground Hold input (READ/HOLD switch on HOLD) or a ground level at the Accessory Hold input. Start/Stop is also set by an External Command received through the remote programming input.

4.58. As Start/Stop is set, the negative-going edge of Start/Stop sets the Reset flip-flop. Reset is inverted to become S9 (Set 9) and applied to each of the Decades. Each Decade has four flip-flops representing X1 - X4 for that Decade. S9 sets the Decades to 99999. If, with the five Decades set to nines, DAC current is less than the input, the Overflow flip-flop is turned on by Overflow detecting logic on the Sequence Logic board. This adds additional DAC current representing a sixth digit (100K). If the resulting DAC current is still too low, the digitizing cycle is completed and the unit is made to up-range. If no higher range is available or permitted, the overrange condition (109999) is read out to indicate an excessive input.

4.59. Normally, however, the initial setting of 99999 results in a DAC current greater than the input current. This condition is detected by logic on the Sequence Logic board; the Sequence Counter is stepped to sequence state 1 (S1).

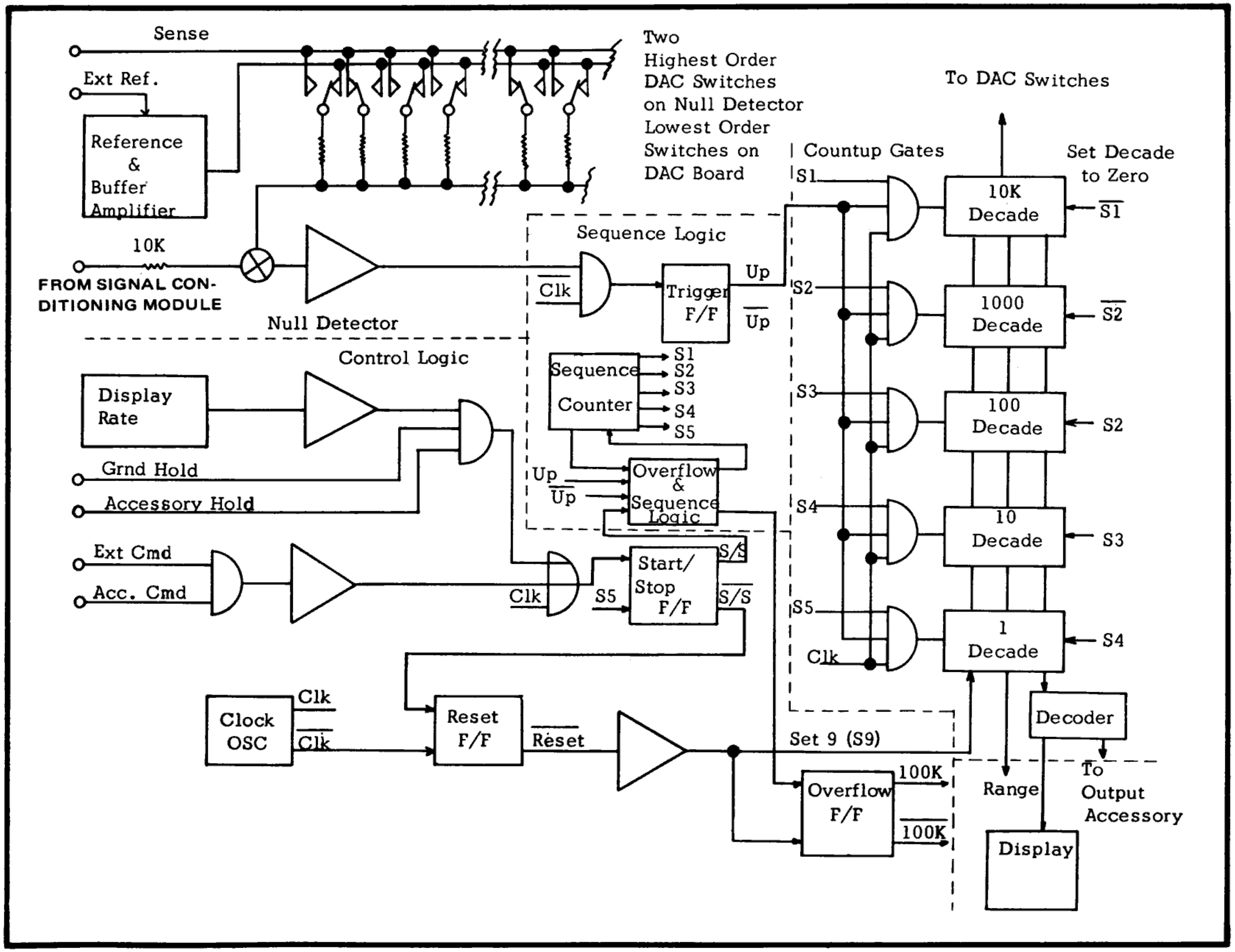


Figure 4.6. Block Diagram - Digitizing & Display Module

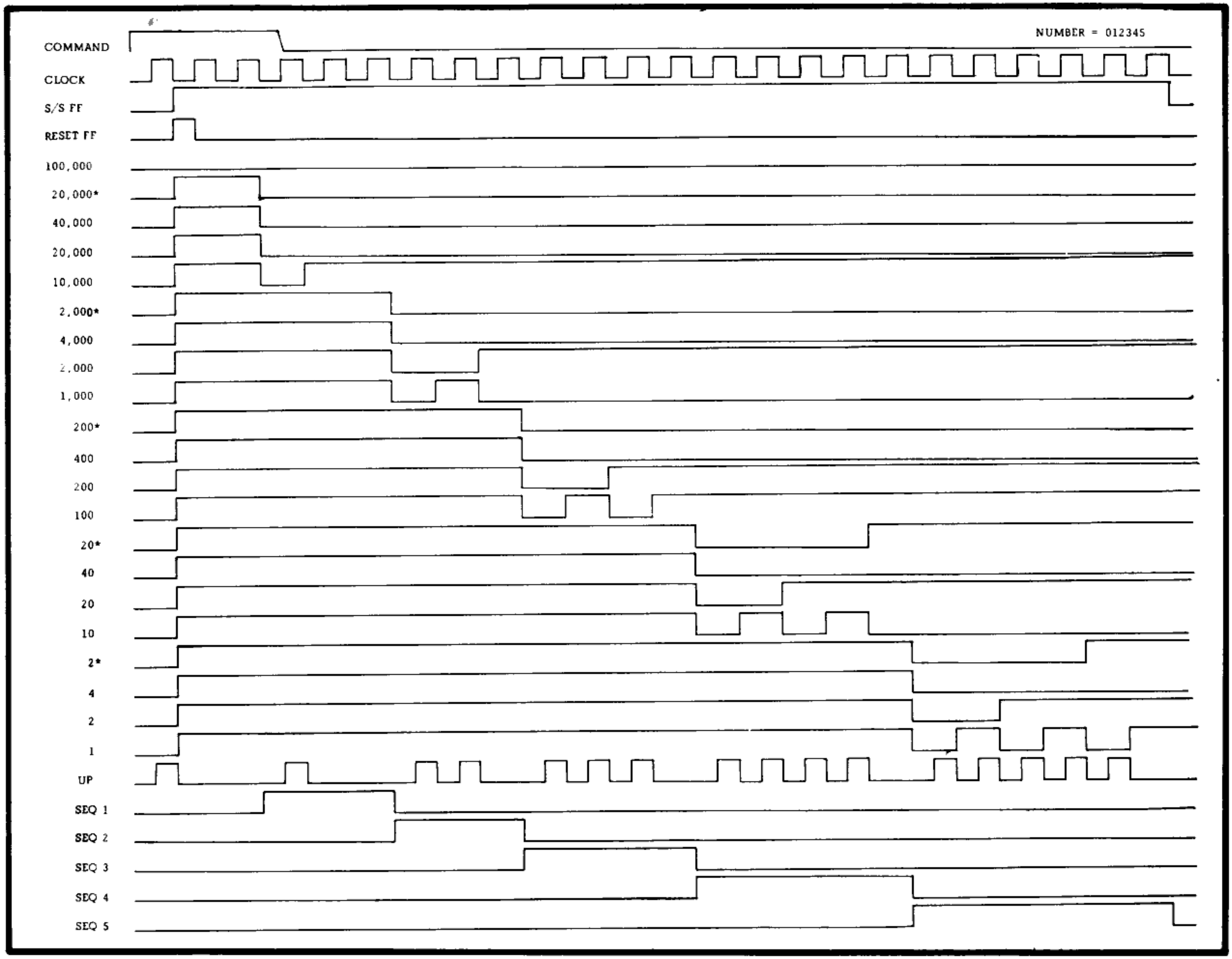


Figure 4.7. Model 5500 Timing (Without Overrange)

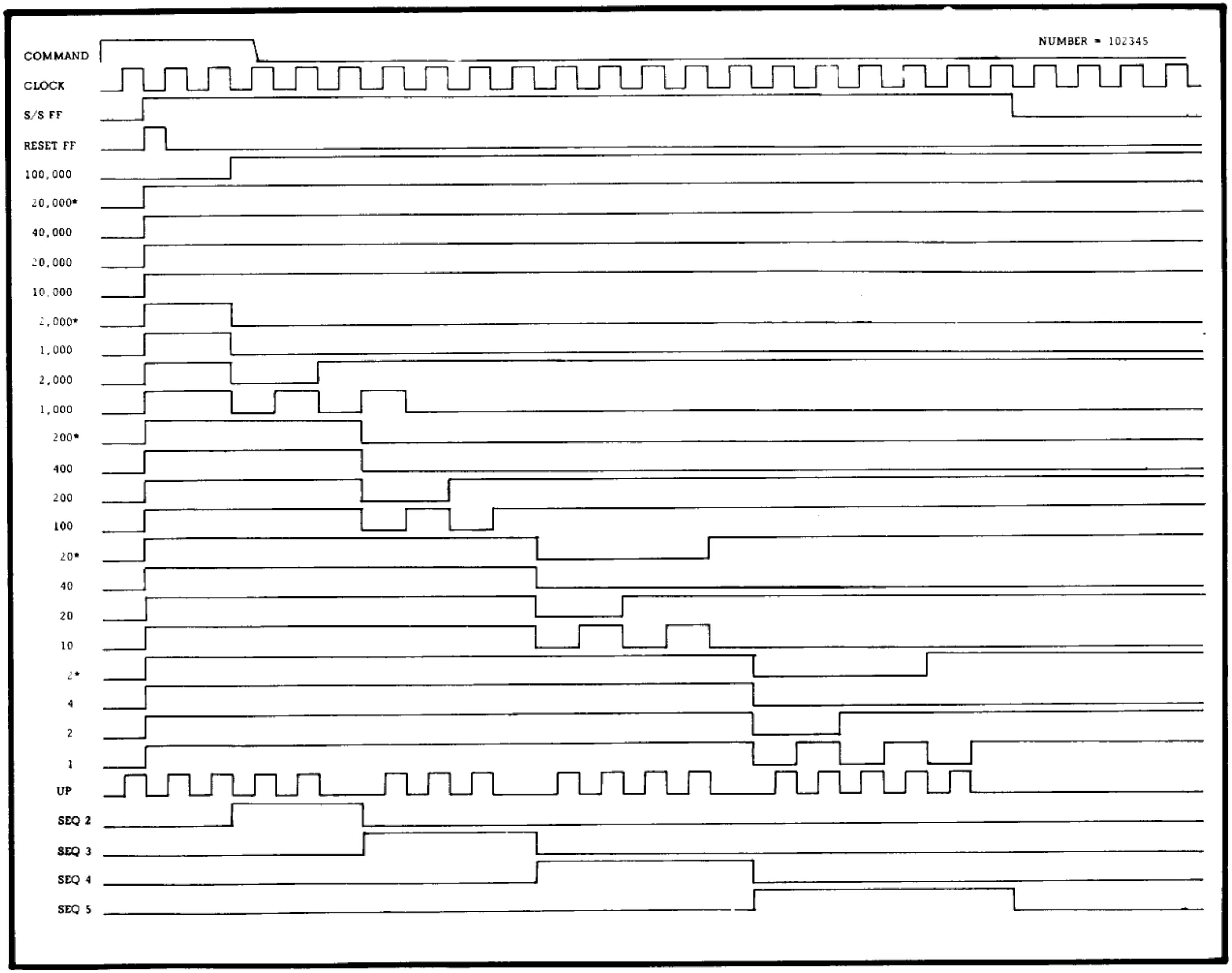


Figure 4.8. Model 5500 Timing (With Overrange)

4.60. In S1, the 10K Decade is "dropped" (each flip-flop "off"). The Decades are now set to 09999. If the resulting DAC current is less than the input current, the Null Detector causes the generation of UP at the Trigger flip-flop. The 10K Decade now counts up on each clock pulse until DAC current becomes equal to or greater than the input current. This condition is indicated by an $\overline{UP}$ from the Null Detector. The Sequencer then advances to S2 and the 1000 Decade is set to zero. If DAC current is less than the input current, the 1000 Decade is counted up in the same manner as the 10K Decade. This is repeated for each succeeding Decade. At the end of the S5, during which the 1 Decade is counted up, the Start/Stop flip-flop is turned off. At this time, the state of the Decades represents the digital value of the input signal and the conversion is complete. This operation is illustrated in the timing diagram of Figure 4.7. In the illustration the input is 012345. Figure 4.8 shows the timing with overrange.

4.61 NULL DETECTOR (Schematic 430379)

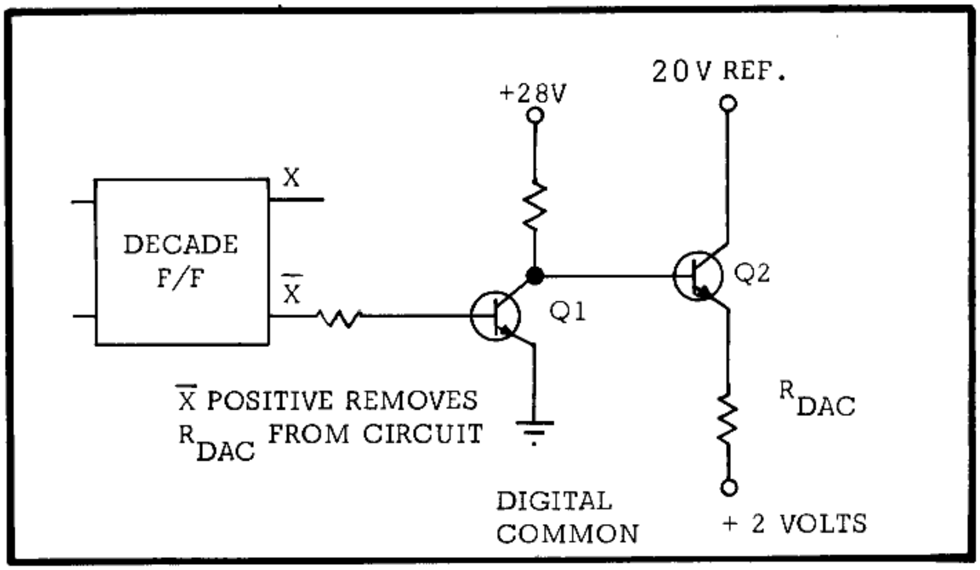
4.62. There are two main elements on the Null Detector circuit board; the two highest order Decade precision DAC (digital/analog converter) resistor matrices controlled by the state of the Decade flip-flops—and the Null Detector itself, an amplifier that detects and amplifies any difference in input current and DAC current.

4.63. A summing junction at the input to the Null Detector receives the negative input from the Signal Conditioning module and the DAC current. The two currents are balanced out by the DAC resistor network. The DAC current is developed from a precise 20-volt reference voltage from the Reference Buffer circuit board for absolute measurements or from an external reference when ratios are being measured.

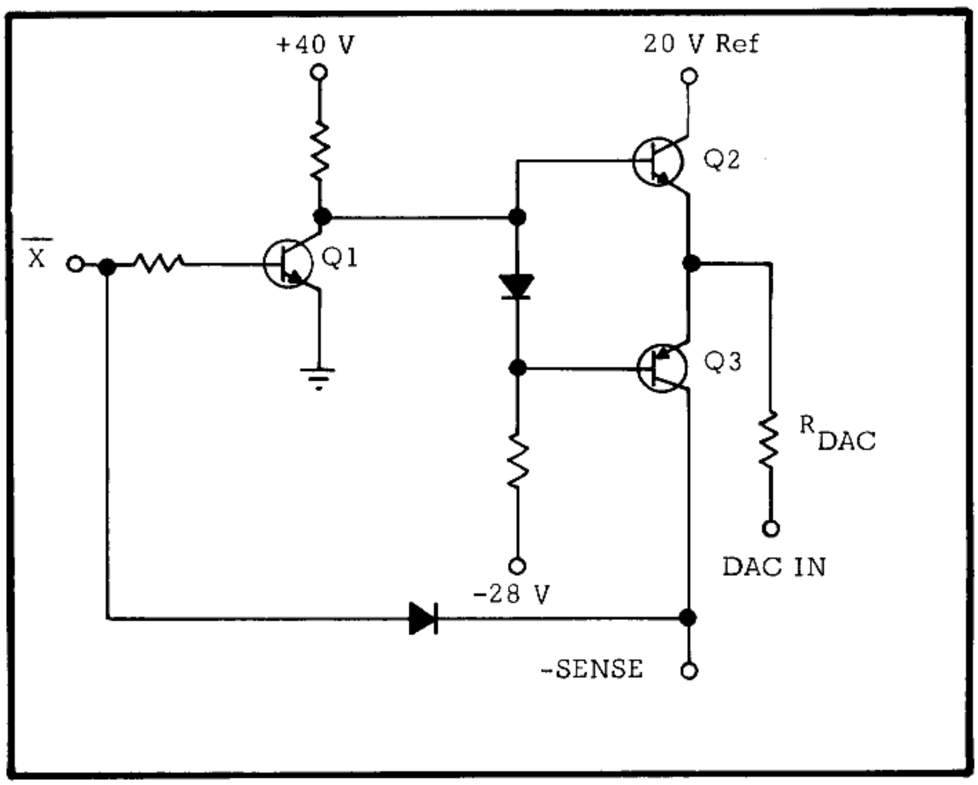
4.65. A typical DAC switch in the highest order decades is shown in Figure 4.9a. Q2 is normally on and R_{DAC} is in the circuit. When a positive voltage is applied to the base of Q1, Q1 is turned on and the resulting ground level at the base of Q2 back biases Q2 and R_{DAC} is out of the circuit. As shown in the figure, the switch is operated by the "not" side of the Decade flip-flop. When the flip-flop is "off" ("not" side true), the resistor is out of the circuit. Therefore, as a decade is counted up, resistance is added in parallel and DAC current increases at each step.

4.64. Two types of DAC switches are used: one for the lowest order decades (1, 10, 100, and 1000) and a different type for the highest order decase (10K). The 10,000 Decade switches and 1000 Decade, switches are located on the Null Detector board. The balance of the switches are on the DAC board (Schematic 430376).

4.66. A typical DAC switch for lowest order decades is shown in Figure 4.9b. Q2 is normally on, Q3 is normally off, and R_{DAC} is effectively connected to the reference supply. When a positive voltage is applied to the base of Q1, Q1 is turned on, biasing Q2 off and Q3 on; R_{DAC} is now effectively connected to negative sense. The junction voltage drops across Q3 are compensated for by R65 and CR11. As shown in the figure, the switch is operated by the "not" side of the decade flip-flop. When the flip-flop is "off" ("not" side true) the resistor is tied to the reference voltage.



(a) Highest Order Decade



(b) Lowest Order Decade

Figure 4.9. Typical DAC Circuits

4.67. The positive DAC current is applied to the summing junction at the Null Detector input. If the DAC current is greater than the negative current from the Signal Conditioning module, the resulting current is positive; if the Signal Conditioning input is greater, the resulting current is negative. The Null Detector is a high-gain amplifier that provides an output of sufficient amplitude to trigger the Trigger flip-flop only when the input (summing junction) is negative. The Trigger flip-flop is located on the Sequence Logic board; its output is the UP signal. UP and its complement, $\overline{UP}$, control generation of the sequence states which, in turn, control the counting operation of the Decades.

4.68 DECADES (Schematic 430390)

There are five Decade boards in the instrument, all identical. The Decade board nearest the front of the instrument controls the 10,000 digit; the second board the 1000 digit; the third, the 100 digit; the fourth, the 10 digit; and the fifth, the 1 digit.

4.69. At the beginning of a conversion, after the Start/Stop and Reset flip-flops (on Control Logic board) are set, the S9 line is made "true". This applies a positive voltage to the reset side of each flip-flop and represents "all to nine" condition. If the Null Detector indicates that 99999 is greater than the input signal, the Sequence Logic places the instrument in sequence state 1 (S1). S1 is applied to the C_o input of the 10K Decade. As S1 goes "true", the negative-going edge of $\overline{S1}$ places a negative voltage on the reset input of the flip-flop, thereby resetting it to zero. The "true" output of the flip-flop and of each remaining flip-flop on the Decade resets the following flip-flop as it goes "false" (on negative-going edge). Each flip-flop on the 10K Decade is now "off" and the value represented by the four Decades has changed from 99999 to 09999.

4.70. S1 is applied to the input gate along with UP and a clock pulse. The Decade counter now counts up on each clock pulse. (Sequence state 1 (S1) enables count-up of the 10K Decade; S2, the 1K Decade; S3, the 100 Decade; S4, the 10 Decade; and S5, the 1 Decade). Counting continues until UP goes FALSE. At this time, the Sequence Logic places the instrument in sequence state 2 (S2) and the 100 Decade is reset by S2 applied to the C_o input. The count-up operation proceeds exactly as the 10K Decade, except that the input gate is now enabled by S2. The 100 Decade and 10 Decade counting operations begin on following UP signals. At the end of the 1 Decade counting operation (S5), the Sequence Logic counter and Start/Stop flip-flop are reset and no further sequence states are generated until the Start/Stop flip-flop is again set.

4.71. The "and" gates at the inputs to the 2 and 2* flip-flops adjust the count to eliminate "forbidden codes". Additional gates on the board receive various outputs from the flip-flops to detect the 0 and 9 states of the Decade for use of the range circuits in the Signal Conditioning module.

4.72. Also included on the Decade circuit board is a Decoder that interprets the state of the flip-flops and produces the drive voltage for the numerical display and the BCD data to the digital output accessory. There are five lines to the lamps, each representing a pair of numerals: 0 and 1, 2 and 3, 4 and 5, etc. Separate control lines determine whether the even or odd numeral is to be lit. During the digitizing cycle, a blanking signal inhibits both the odd and even enable lines.

4.73 SEQUENCE LOGIC (Schematic 430393)

4.74. A counter on the Sequence Logic circuit board generates the five sequence states—or periods during which each Decade is reset to zero and then counted up. In addition, logic gates on the board determine when the sequence counter is turned on — and also detect the "overrange" condition where the input exceeds the five-digit capability of that range. Operation of the Sequence Logic is described in the following paragraph. In the first case, it is assumed that the input does not require the overrange function.

4.75. As S1 goes "true" $\overline{S1}$ goes "false". The negative-going edge of $\overline{S1}$ resets the 10K Decade to zero (as explained under "Decades") and S1 enables the input gate to allow the Decade to start counting. The 10K Decade counts up until UP is received. UP resets the S1 flip-flop in the sequence counter. On the negative-going edge of S1, flip-flop S2 is set. The negative edge of S2 resets the 1K Decade to zero. S2 enables the input gate of the 1K Decade and it begins counting.

4.76. The Sequence counter advances to S3 on the next UP and the 100 Decade count operation is performed. S4 controls the counting of the 10 Decade, and S5 controls the counting of the 1 Decade. The negative-going edge of S5 resets the Start/Stop flip-flop.

4.77. The function of each sequence state can be summarized as follows:

$\overline{S1}$ resets 10K Decade to zero (on negative-going edge);

S1 enables 10K Decade count-up;

$\overline{S2}$ resets 1K Decade to zero (on negative-going edge);

S2 enables 1K Decade count-up, resets 100 Decade to zero (on negative-going edge);

S3 enables 100 Decade count-up, and resets 10 Decade to zero (on negative-going edge);

S4 enables 10 Decade count-up, and resets the 1 Decade;

S5 enables 1 Decade count-up and resets the Start/Stop flip-flop.

4.78. The overrange condition exists when, after the Decades are initially set to 99999, an UP is received. This indicates that the value represented by the state of the Decades is full-scale but still less than the input signal. This condition is detected by an "and" gate on the Sequence Logic board which receives the UP signal along with the clock, Start/Stop, and the "not" outputs of the sequence counter flip-flops. When UP enables this gate, a signal (Set 100K) is sent to the Control Logic board where it sets the overflow flip-flop. The overrange bit has a logical weight of 100,000. If the overrange bit is "true", the readout is 10XXXX. For reasons of linearity and accuracy, the analog weight of the resistor associated with this bit is 10,000. This requires that the 10K decade be set to 9 and results in a total weight of 9 + 1 or 10. The readout does not indicate 199999 but the true analog weight of 109999.

4.79. If, after the overrange bit is set, the new comparison at the Null Detector results in an $\overline{UP}$, this indicates that the input is some value between 99999 and 109999. The negative-going edge of 100K places the instrument into sequence state 3 and the conversion proceeds as described before, but with the 10K position remaining at 9 and the 1000 Decade the first Decade "dropped".

4.80. If, after the overflow bit is set, an UP is received — indicating that 109999 is still less than the input, a digitizing cycle is not performed and the unit is made to uprange (if instrument equipped for auto range). If no higher range is available, the overrange indication of 109999 is displayed (printed) to indicate an excessive input.

4.81 CONTROL LOGIC (Schematic 430685)

4.82. The conversion operation begins when the Start/Stop flip-flop is set. Start/Stop is set either automatically, by the Display Rate circuit, or by an external command.

4.83. The Display Rate circuit is an oscillator which delivers a pulse every 250 milliseconds when the READ/HOLD switch is in the READ position. The oscillator output is inverted and applied to an "and" gate. The gate is inhibited when the READ/HOLD switch is in HOLD — or by Accessory Hold if the line is at ground level. The Start/Stop flip-flop is set on the negative-going edge of Display Rate signal. Start/Stop is also set when an external command is received through the programming input.

4.84. As Start/Stop (S/S) is set, the negative-going edge of $\overline{S/S}$ sets the Reset flip-flop. RESET is applied through an inverter to the Decades as S9 (Set 9). It sets the Decades to 99999 and resets the Overflow flip-flop to zero. The Reset flip-flop is turned off by the next $\overline{CLOCK}$.

4.85. The "true" output of the Start/Stop flip-flop is applied to an inverter. The inverter output is the blanking level which biases off the display lamps during the digitizing process. At the end of a conversion, Start/Stop is turned off by S5 (negative-going). This releases the blanking signal and, at that time, the state of the Decade is displayed.

4.86. The Overflow flip-flop is set by the Set 100K signal from the Sequence Logic board. Its output operates a corresponding DAC switch in the Null Detector representing a "1" digit in the 100K position. This feature allows an overrange voltage to be measured and displayed.

4.87 REFERENCE AND BUFFER AMPLIFIER (Schematic 430395)

4.88. The reference and Buffer Amplifier board serves two functions: it produces a precise 20-volt internal-reference output for absolute measurements, and it serves as a high input impedance, low-output impedance, buffer amplifier for external reference voltages used in ratio measurements. In ratio mode, this amplifier has a gain of 2. A relay on the board (K1) switches the circuit from an internal reference voltage supply to a buffer for the external reference voltage when energized by the RATIO command.

4.89. The internal reference circuit is based on the use of an aged Zener diode. The Internal Reference is a

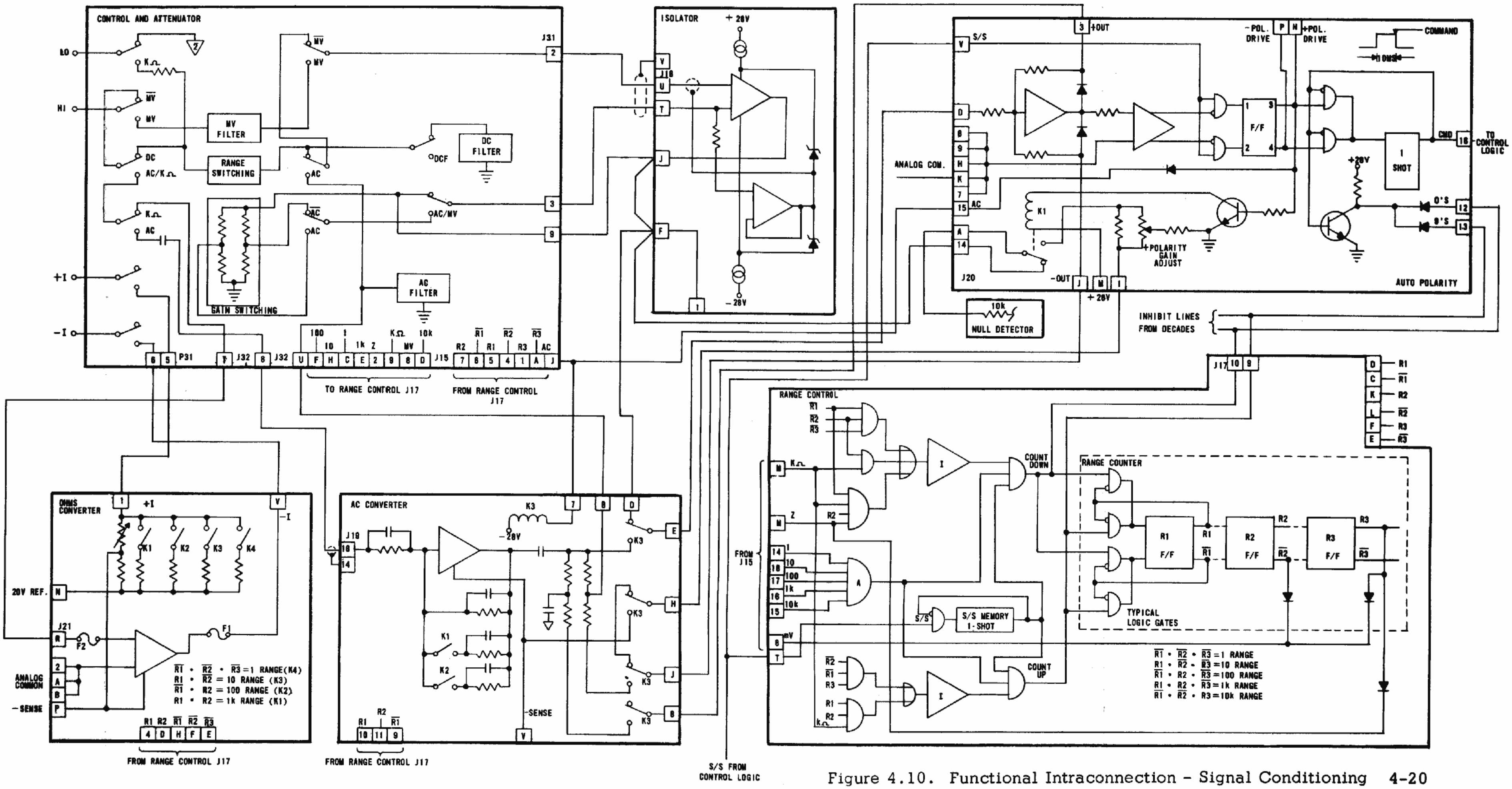


Figure 4.10. Functional Intraconnection - Signal Conditioning

SECTION 5

TROUBLESHOOTING & MAINTENANCE

5.1 INTRODUCTION

5.2. This section is to be used as a supplement to the schematics and assembly drawings of Section 6. Contained in this section are troubleshooting guides, power supply voltages, parts ordering information, and calibration procedures.

> WARNING
>
> Potentials over 300 volts are used in the instrument in the locations listed below:
>
> Power supply
>
> Display tubes
>
> Display board
>
> Decade boards
>
> Range control board

5.3 MECHANICAL DISASSEMBLY

5.4. Troubleshooting the instrument at the circuit board level can be accomplished without removing the chassis from the sealed case. It is only necessary to slide the chassis out part way. This allows all boards except the Control and Attenuator and Display boards to be replaced (see 5.6).

(a) Remove power from DVM.

(b) Loosen the eight captive allen screws around the front panel and slide the drawer forward to the stops. This allows access to the circuit boards.

(c) Before applying power, check for mechanical short between guard and case and between guard and input common.

CAUTION: When operating instrument with chassis partially removed, disconnect guard clip on input cable from the source to prevent possible damage to external voltage supply by grounding point to which guard is attached.

5.5. If, when the procedures in this section are followed and it is determined that the malfunction is not due to a faulty circuit board, it is necessary to completely remove the chassis from the case:

(a) Remove cable support rod from DVM chassis.

(b) Disconnect cables from rear of chassis.

(c) Slide chassis out of case.

5.6. The Control and Attenuator board and the Display board are each secured by two screws installed through the bottom plate of the chassis. These screws are accessible with the chassis removed from the case. In removing the Control and Attenuator, it is also necessary to drop the front panel by removing three screws on either end of the panel. After the panel is dropped, the screws should be replaced to support the card guide.

5.7 POWER SUPPLY

5.8. When checking for any major trouble in the DVM, make the following routine check of the power supply.

(a) Apply power to instrument.

(b) Set MODE switch to READ. If readout is blank, refer to figure 5.1.

(c) The power supply voltages are most easily checked by placing the Null Detector board (J8) and one of the Decade boards (J2 through J6) on extenders and measuring the voltages at the pins indicated in table 5.1. If any of the voltages are low, indicating a short, isolate the cause by removing all boards. If the low voltage still exists, the problem is in the power supply itself (see schematic 430701) or a shorted strap on the main circuit board. If the voltage returns to normal, replace the boards, one at a time, until the board having the short is found.

5.9. If the power supply appears to be operating normally, refer to the Initial Checkout Procedures (2.13). In addition, perform the following check:

(a) Set RANGE to AUTO

Table 5.1. Power Supply Voltages

Pin	Schematic Ident.	Nominal	Ripple
J8-4	+40V	+52V	500mV
J8-T	+28V	+32V	500mV
J8-U	-28V	-32V	500mV
J8-N	+18V	+17V	5mV
J8-V	-18V	-17.5V	5mV
J2-V	+2V	+2.2V	20mV
J2-P*	+14V*	+16V	225mV
J2-10*	+300V*	+350V	500mV

* Referenced to digital common, J2-N; other voltages referenced to analog common, J8-P.

(b) Set FUNCTION to DC

(c) Set MODE to READ

(d) Set POWER to ON

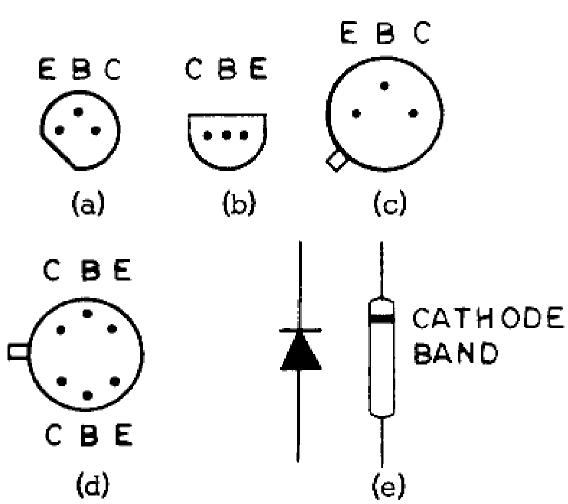
(e) Connect the signal input leads to a source of variable DC. Slowly increase the DC source voltage from zero to 10 volts. Check the DVM for problems covered in figures 5.4 and 5.5.

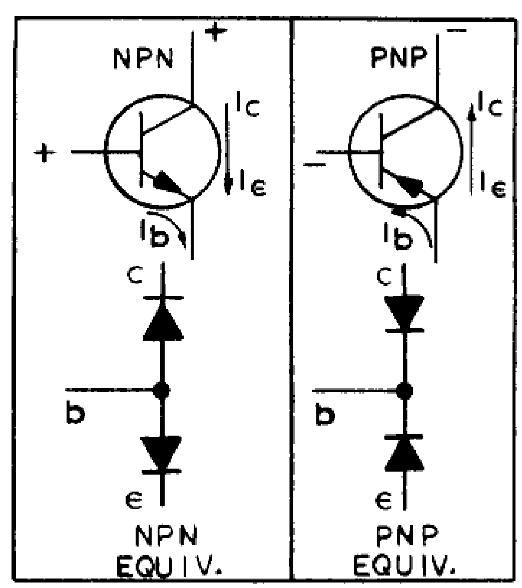
5.10 BOARD SUBSTITUTION

5.11. When spare boards are available, the most effective method of isolating a malfunctioning board is by substitution. Replace all boards in the DVM with spare boards. If the problem persists, the malfunction is narrowed down to that portion of the DVM still remaining. If the DVM is functioning normally with the spare boards, replace the spare boards, one at a time, with the original boards until the problem reappears. Repair or replace the malfunctioning board.

Table 5.2. Component Characteristics

Identity	Configuration (See Below)	Type	Usage	Notes
009	c	PNP	Medium power	Case Common to Collector
012	b	PNP	Analog	Epoxy
014	c	NPN	Medium power	Case Common to Collector
015	d	Dual NPN	Low level 1st stage	Case insulated
016	d	Dual NPN	Low level 1st stage	Case insulated
2N3565	a	NPN	High gain analog	Epoxy
2N3646	a	NPN	High speed digital	Epoxy
007	e	Diode	Low leakage	Glass
018	e	Diode	Logic	Glass
SD4	e	Diode	Power	Epoxy
1N916	e	Diode	Low leakage	Glass
1N9586	e	Zener	7.5v	Glass
1N961b	e	Zener	10v	Glass
1N967b	e	Zener	18v	Glass or Epoxy
M24A25	e	Zener	2.4v	Glass





5.12 VISUAL INSPECTION

5.13. Check a malfunctioning board visually for burned components, loose connections or any other abnormalities which could cause problems. Check also the printed circuit fingers which form the pins of the male connector at the bottom of the board for oil, dirt, etc. The fingers can be cleaned with a solvent or a common pencil eraser.

5.14 RESISTIVE CHECK

5.15. Component failures such as shorted capacitors, open resistors, and shorted or open semiconductors are easily located by checking the resistance of a component with a VOM.

5.16. DIODES. Resistance readings taken of diodes vary according to the range and type of VOM used. However, the forward biased resistance is usually in the order of a few hundred ohms and the front-to-back ratio is in the order of 1000 or more.

5.17. ZENERS. Zener diodes may be checked in the same way as diodes and will show whether the diode junction of the zener is open, shorted or normal (zeners tend to appear leaky). However, only by applying power to the device can the voltage regulating properties of the zener be checked.

5.18. TRANSISTORS. With respect to their junctions, transistors are two diodes connected together with the base lead connected in the middle (see table 5.2). These two "diodes" are checked for their forward and back resistance. In addition, a check is made across the emitter and collector for any leakage.

5.19 BIASING

5.20. When resistive checks of the components fail to discern the cause of the trouble, normal circuit tracing techniques are used. The most useful of these involves the checking of operating levels or "biasing" of the active components.

5.21. DIGITAL. Digital circuitry performs all of its functions using only two logic states: +14 volts and digital common. These two levels are normally referred to as "true" and "false" and may be in the form of pulses or levels. Diodes are used as gates and pass or reject data according to whether the diodes are forward or reverse biased. Transistors are used as inverters. A logic true at the input of an inverter results in a logic false at the output and a false input results in a true output. Flip-flops can be analyzed as two inverters with inputs and outputs interconnected. In the biasing of logic transistors the collector is either at digital common (actually about 0.2 volts above) or at a positive voltage determined by the load on the output, the collector resistor, and the supply voltage (normally +14 volts). For the collector to be false, the transistor is turned on by a sufficient amount of current entering the base. The voltage from emitter to base is between 0.6 and 0.7 volts on all logic transistors.

5.22. ANALOG. In analog circuitry, the transistor collector is biased at some potential less than the supply voltage but more than the base voltage. Varying the base-emitter current results in a corresponding change in collector current and collector voltage such that increasing the base-emitter current causes an increase in collector current. The increased collector current results in an increase in the I-R drop across the collector load and the collector voltage becomes nearer the base voltage. Less base-emitter current results in a collector current nearer the supply voltage. Check transistors for transistor action

Table 5.3. Decade Fault Isolation

MALFUNCTIONING DECADE	DISPLAY READOUT	CONTROLLING SEQUENCE F/F
10K	099999	1
1K	009999	2
100	000999	3
10	000009	4
1	*000000	5

*May have double number

The Display Readout column represents the position of the DAC when the sequence count is interrupted by: (1) a malfunctioning decade board, or (2) a malfunctioning sequence F/F. Remove the decade board whose corresponding display readout most nearly matches the DVM display.

by shorting together the base and emitter leads and observe that the collector returns to the supply voltage.

5.23 TROUBLESHOOTING CHARTS

5.24. Unless otherwise noted, the following troubleshooting charts, (figures 5-1 through 5-5) are valid only when the instrument is programmed as stated below.

(a) Set RANGE to 10

(b) Set FUNCTION to DC

(c) Set MODE to READ

(d) Set POWER to ON

(e) Connect SIGNAL INPUT leads (J101 pins N and P) together.

5.25 ORDERING PARTS

5.26. Standard parts can be obtained through Dana Laboratories Incorporated, its local representatives or through other vendors. Consult parts list in section 6 for value, tolerance and rating. When ordering parts include the following information:

(a) Instrument type

(b) Description of part including reference designator, Dana part number, and component type

(c) Name of printed circuit board (if applicable)

5.27 PARTS REPLACEMENT

5.28. The following material is recommended for parts replacement:

(a) 60/40 rosin core solder

(b) wire braid - thin

(c) rosin flux

(d) rosin solvent - such as percloroethylene

(e) moisture resist (type 1A27 or equiv.)

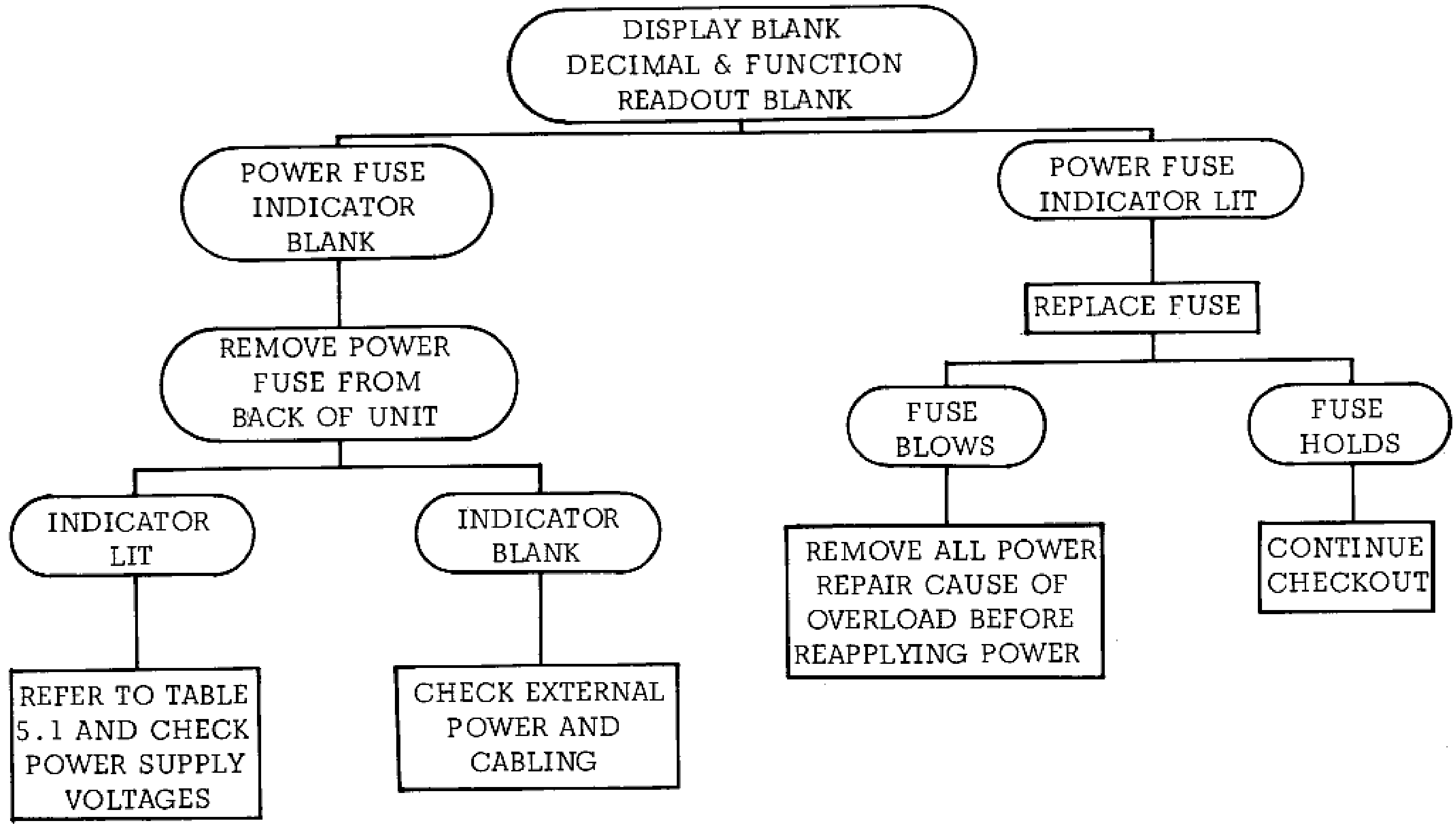


Figure 5.1. Troubleshooting - Display, Decimal & Function Readout Blank

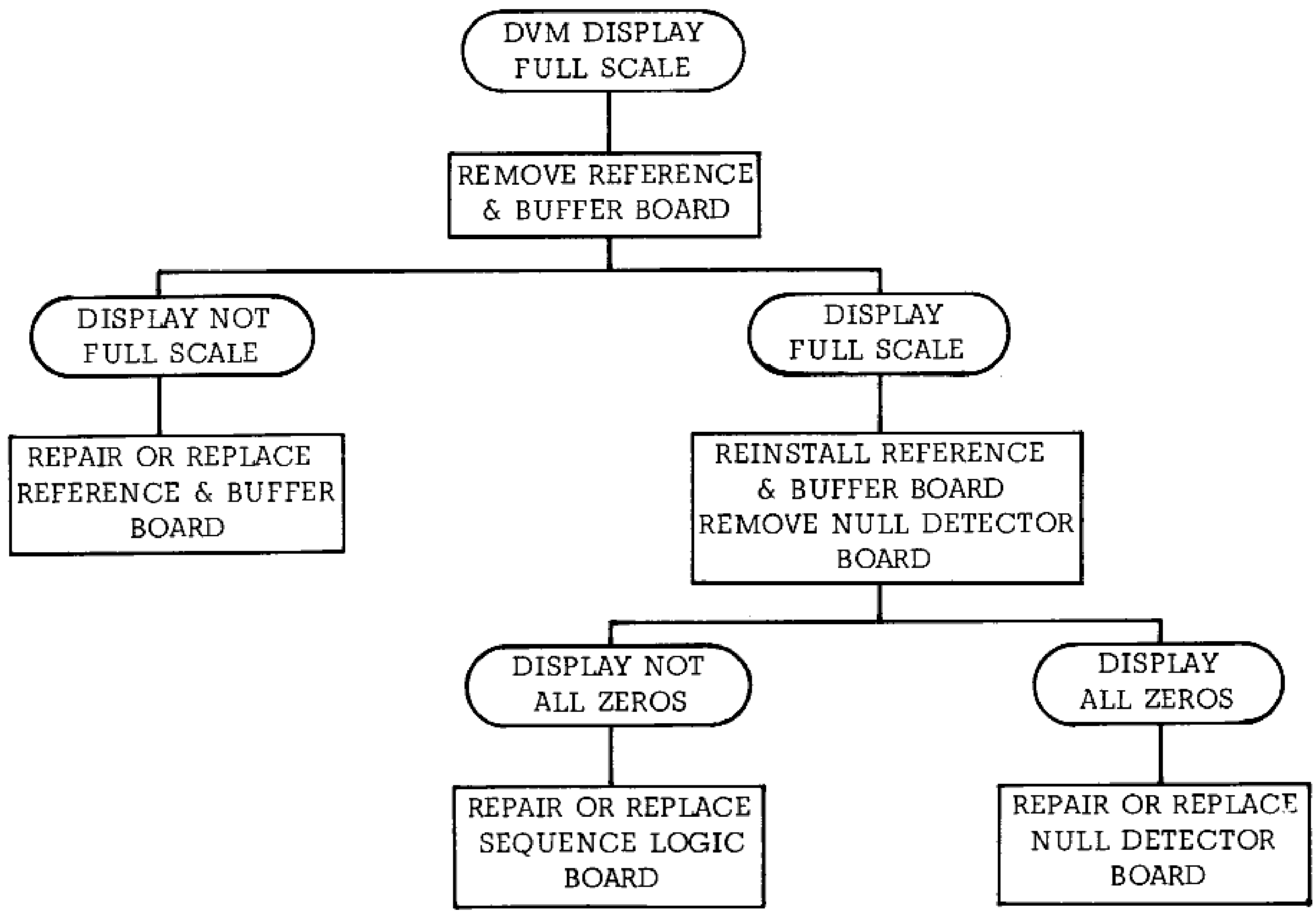


Figure 5.2. Troubleshooting - Display Full Scale

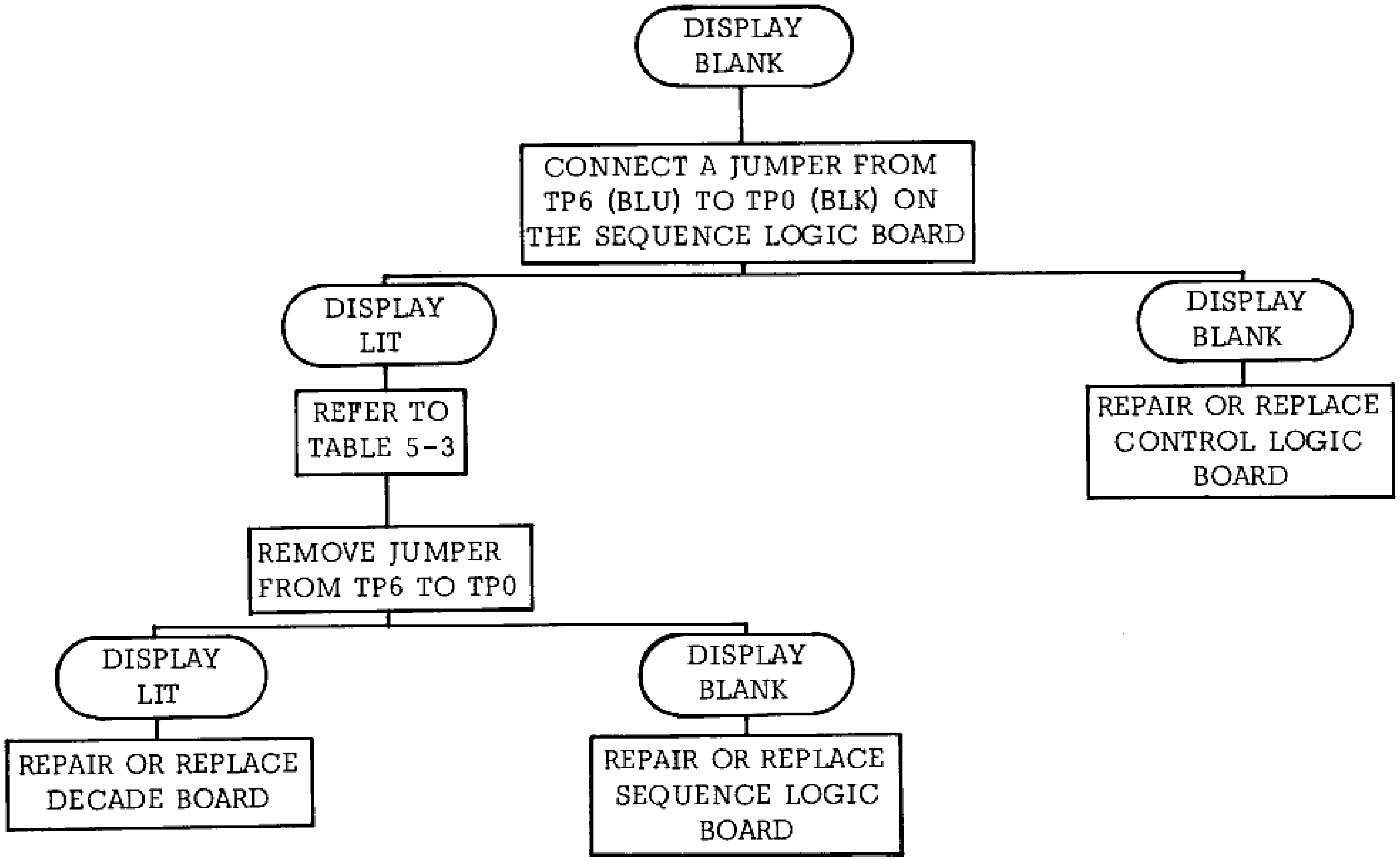
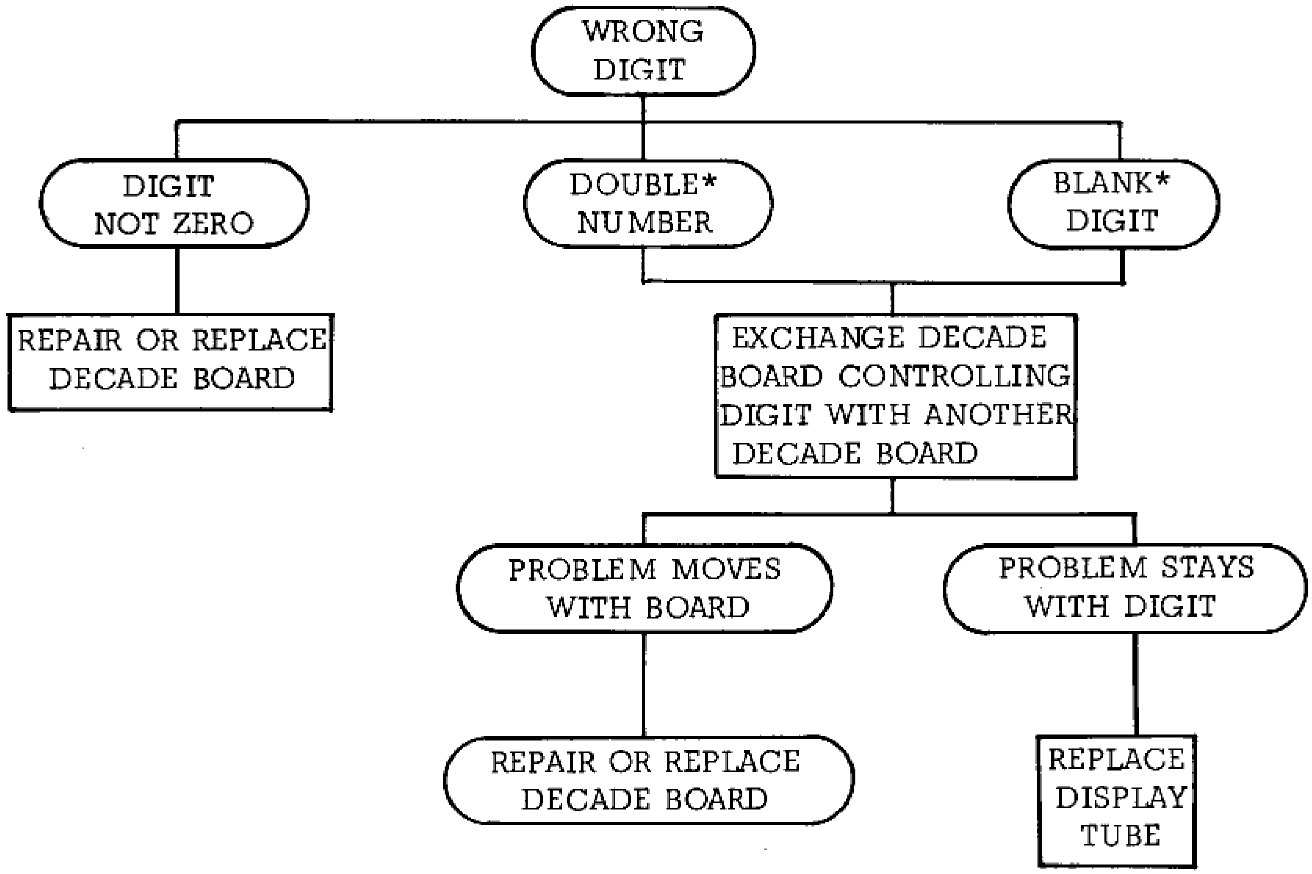
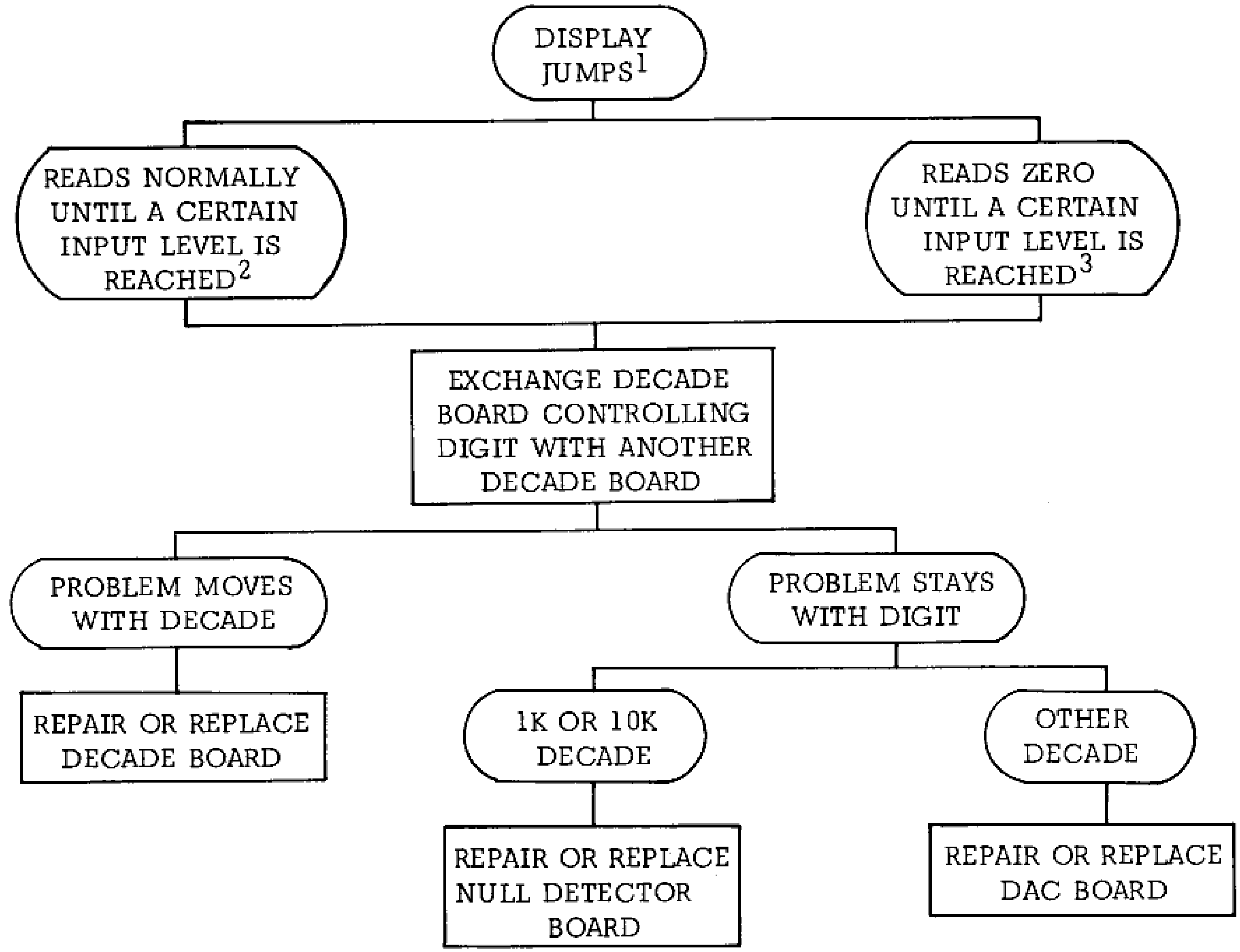


Figure 5.3. Troubleshooting - Display Blank



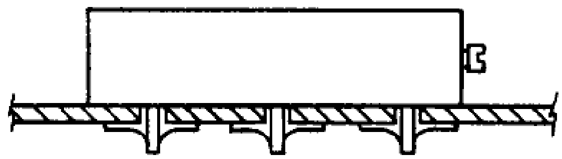
*On certain input voltages

Figure 5.4. Troubleshooting - Wrong Digit



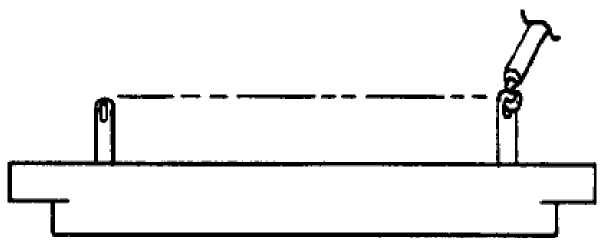
1. With input increased from zero to full scale
2. DAC switch open or held off
3. DAC switch shorted or held on

Figure 5.5. Troubleshooting - Display Jumps

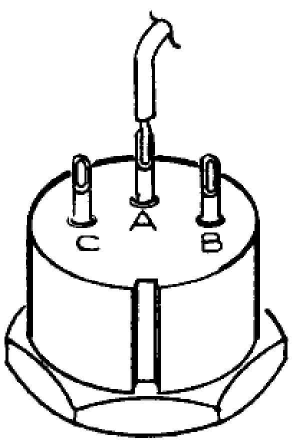


(a) Soldered, flush mounted potentiometer

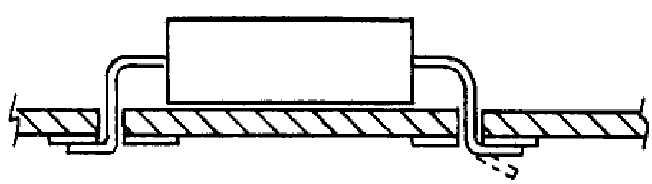
(b) Pre-soldering lead preparation, terminal mount



(c) Pre-soldering wire preparation, flat pin connector



(d) Pre-soldering wire preparation, tabular pin connector



(e) Pre-soldering lead preparation, printed circuit

Figure 5.6. Component Installation

5.29. The following steps should be taken to replace components on printed circuit boards.

(a) Dip one end of the wire braid in flux and place it on the solder joint on the back of the printed circuit board. Use care to keep the braid on the etch circuit to prevent burning of the board.

(b) Place the tip of the iron firmly against the braid until the solder is observed on the braid.

(c) Remove the iron and the braid from the board. Lift the lead away from the etch pad with the diagonal wire cutters and straighten the lead with a pair of long-nose pliers.

(d) Repeat the above steps for each lead on the component.

(e) When the lead is perpendicular to the board, pull the lead through the hole in the board with a pair of pliers.

(f) Remove the flux and burned moisture resistant coating from the board with a flux solvent.

(g) Bend the leads of the replacement component to line up with the holes on the circuit board. Holes filled with solder can be opened by heating pad with the soldering iron and using a toothpick or other soft pointed object to clear the hole.

(h) Insert the leads and seat the new component firmly against the board. Bend leads if required and cut as shown in figure 5.6.

(i) Apply enough solder to cover wire and strap. Both wire and strap should be discernible. Apply just enough heat to the component lead to allow the solder to flow freely.

(j) Clean new solder connection with a flux solvent. Apply a thin coat of moisture resist.

5.30 CALIBRATION

5.31. The calibration of the Model 5524 is designed to keep the instrument operating within its specifications for indefinite periods of time. Access to calibration components is made by removing the eight screws that secure the front panel to the case and pulling the drawer out of the stops.

5.32. All calibration points involved in the calibration of the Model 5524 are shown in Figure 5.7. Field calibration procedures are listed in table 5.4. "Factory Only" adjustments are described in 5.48.

5.30 REQUIRED CALIBRATION EQUIPMENT

5.34. The equipment required by the user for the calibration of the Model 5524 is listed below.

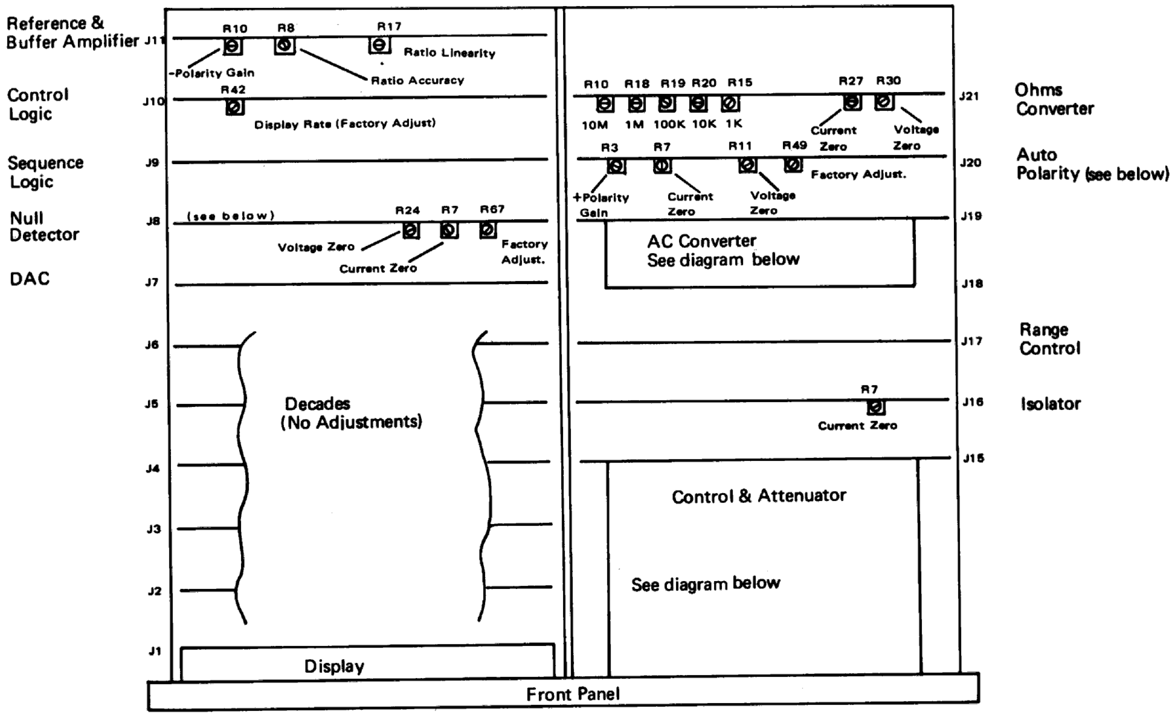
(a) Service card extender DP/N-400839 (supplied by Dana Laboratories, Inc.)

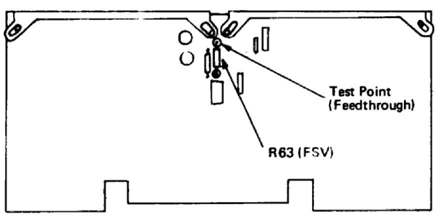
(b) Precision null-type microvoltmeter (Fluke 845AR or equivalent)

(c) Precision DC power supply (COHU Model 326 or equivalent)

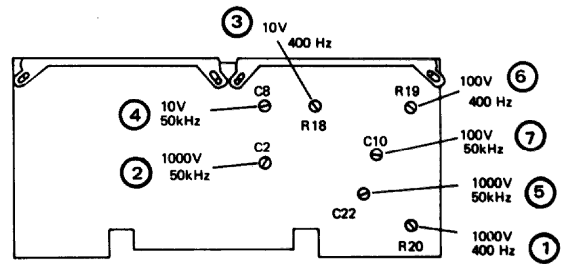
(d) Precision voltage divider (E.S.I. Dekavider RV622A or equivalent)

(e) Precision AC source

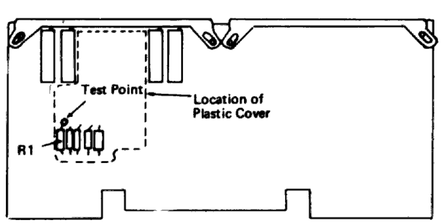




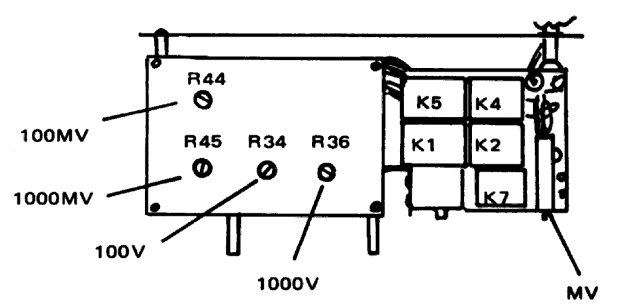
Null Detector Test Point



AC Converter
(Front View)



Auto Polarity Test Point



Control & Attenuator
(Top View)

Figure 5.7. Calibration Points

Table 5.4. Field Zeroing Procedure

The following procedure can be used as a field zeroing procedure or when the zero is just slightly out of adjustment. It still requires that the chassis be pulled partially out of the case, but an extender is not required.

(a) Set FUNCTION to DC, RANGE to AUTO, and MODE switch to READ.

(b) Short input leads together.

(c) Connect microvoltmeter to left side of C3 on Isolator board (see assembly drawing).

(d) Adjust MV ZERO potentiometer on front panel for a microvoltmeter reading of zero ± 10 μvolts.

(e) Apply an input signal of -1.0 mV. Adjust the null detector current zero potentiometer (R7) until the readout bounces between -00.0009 and -00.0010.

(f) Apply an input signal of +1.0 mV. Adjust the autopolarity current zero potentiometer (R7) until the readout bounces between +00.0009 and +00.0010.

(g) Set FUNCTION switch to AC. Check to see that the readout is less than 00.0010 with the input shorted. If not, adjust the Auto Polarity current zero (R7) to bring the readout between 00.0010 and 00.0005.

(h) Check steps (b) through (g) to see that readings are within tolerance given. If a zero reading with shorted input cannot be obtained after completing the above procedure, it will be necessary to use the detailed zeroing procedure (5.37).

(f) Resistance standard

5.35. CALIBRATION PROCEDURE

5.36. For all zeroing operations, the low side of the microvoltmeter is referenced to -SIGNAL INPUT.

5.37. ISOLATOR ZERO

(a) Place isolator board (402477) on extender board.

(b) Set FUNCTION control switch to FAST DC, RANGE control switch to AUTO, and MODE control switch to READ.

(c) Short +SIGNAL INPUT and -SIGNAL INPUT together.

(d) Connect a jumper across capacitor C1.

(e) Connect microvoltmeter lead to left side of capacitor C3.

(f) Adjust MV ZERO control on front panel for 0 $\pm$50 microvolts out.

(g) Adjust current zero potentiometer R7 for 0 $\pm$50 microvolts out.

(h) Repeat steps (d), (f), and (g) to ensure accuracy.

(i) Remove meter connections from Isolator board and reinstall in DVM.

5.38. NULL DETECTOR ZERO

(a) Place Null Detector board on the extender board.

(b) With the DVM Readout Display all zeros and -Polarity, set the MODE control switch to HOLD.

(c) Connect the microvoltmeter lead to the feedthrough supporting the top of resistor R63 on the Null Detector board.

(d) Adjust the current zero potentiometer R7 for a reading of 0 $\pm$10 microvolts on the microvoltmeter.

(e) Remove the microvoltmeter lead from the Null Detector board and replace the board in DVM.

5.39. AUTO POLARITY ZERO

(a) Place the Auto Polarity board on the extender board and remove the plastic shield by removing the two mounting screws.

(b) Set the MODE control switch to HOLD.

(c) Connect microvoltmeter lead, through a series 10K resistor, to the top of the precision resistor R1 (standoff) on the Auto Polarity board.

(d) Adjust the 5K voltage zero potentiometer R11 for 0 $\pm$10 microvolts output on the microvoltmeter.

(e) Remove the microvoltmeter lead from the standoff and remove the Auto Polarity board from the extender. Remount the plastic shield and reinsert the Auto Polarity board in the DVM.

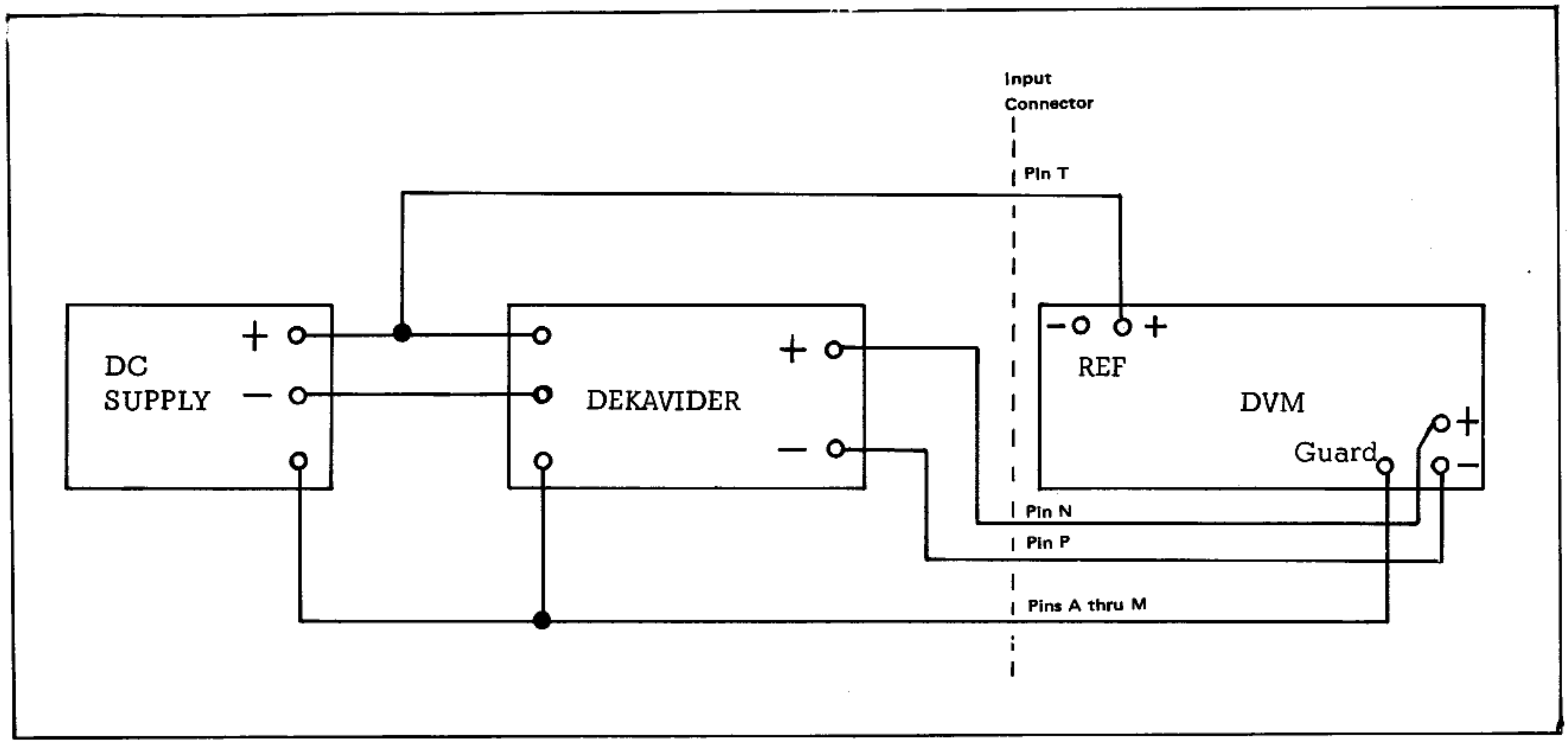


Figure 5.8. Ratio Test Setup

5.40. DVM POLARITY ADJUSTMENT

(a) Place the Isolator board on the extender and connect the microvoltmeter lead to the left side of capacitor C3.

(b) Remove the short from the + and - Input Signal lines and connect to a negative voltage source.

(c) Adjust the input voltage until microvoltmeter reads -1 millivolt.

(d) Adjust the Null Detector voltage zero potentiometer (R24) until Readout Display reads between 9 and 10 digits in equal proportions.

(e) Switch DC Source to Positive polarity and adjust input until microvoltmeter reads +1 millivolt.

(f) Adjust the Auto Polarity current zero (R7) until the Readout Display reads between 9 and 10 digits in equal proportions.

(g) Repeat steps (b) through (f) to ensure accuracy.

(h) Remove the microvoltmeter leads from the Isolator board and reinstall board in DVM.

5.41. RATIO ADJUSTMENT

(a) Set FUNCTION control switch to 10X RATIO.

(b) Connect the DVM as shown in Figure 5.8 with +10 volts power supply voltage and the voltage divider set to 0.999900.

(c) Note the Readout display at +10 volts and reduce the power supply to +2 volts.

(d) Adjust the Reference and Buffer Amplifier board ratio linearity potentiometer R17 until the DVM Readout display at 2 volts and at 10 volts are the same (within 5 digits).

5.42. PLUS AND MINUS POLARITY GAINS

(a) Set FUNCTION control switch to FAST DC.

(b) Connect the Signal Input leads to the Power Supply and select -9.9990 volts.

(c) Adjust the Reference and Buffer Amplifier Minus Polarity Gain potentiometer R10 for a DVM Readout display of -9.9990 volts.

(d) Reverse the Polarity of the Power Supply voltage and adjust the Auto Polarity plus polarity gain potentiometer R3 for a DVM Readout display of +9.990 volts.

(e) Repeat steps (b), (c) and (d) to ensure accuracy.

5.43. RATIO ACCURACY

(a) Set FUNCTION control switch to 10X RATIO.

(b) Connect the DVM as shown in Figure 5.8 with the power supply set at a precise +10 volts. Set the Voltage Divider to 0.999900.

(c) Adjust the Reference and Buffer Amplifier accuracy potentiometer R8 for a DVM Readout display of +9.9990.

(d) Switch the FUNCTION control switch to FAST DC.

(e) Check the DVM Readout for display of +9.9990.

5.44. DC RANGE CALIBRATION

(a) Set FUNCTION control switch to FAST DC and the RANGE control switch to 100.

(b) Connect the Signal Input leads to a known -100 volt source.

(c) Adjust the Control board 100 volt range potentiometer R34 for a Display readout of -100.00.

(d) Set the Range Control switch to 1000 and connect the DVM to a known -1000 volt source.

(e) Adjust the 1000 volt range potentiometer R36 for a Display readout of -1000.0.

5.45. MILLIVOLT RANGE CALIBRATION

(a) Set FUNCTION control switch to MV and the RANGE control switch to 100.

(b) Short input leads together and adjust the MV ZERO control pottentiometer for a DVM readout display of all zeros.

(c) Connect the Signal Input leads to a known 100 MV source.

(d) Adjust Control board 100 MV range potentiometer R44 for a Display readout of 100.00.

(e) Set RANGE control switch to 1000 and connect DVM to known source of 1000 MV.

(f) Adjust 1000 MV range potentiometer R45 for a Display readout of 1000.00.

5.46. AC RANGE CALIBRATION

(a) Place AC Converter board on extender and set the 100 volt capacitor (5) to the middle of its span.

(b) Set FUNCTION control switch to AC and Range Control switch to AUTO.

(c) Connect the Signal Input to the following series of AC voltages and frequencies, adjusting the indicated adjustment until the instrument displays the known voltage value:

Volts, RMS	Frequency	Adjustment (Figure 5.7)
125.00	400 Hz	(1)
125.00	50 kHz	(2)
9.0000	400 Hz	(3)
9.0000	50 kHz	(4)
125.00	50 kHz	(5)
90.000	400 Hz	(6)
90.000	50 kHz	(7)

When all adjustments are completed, check accuracy of ranges at 50 Hz, using voltage inputs of approximately 9.0, 90.0, and 125 volts.

(d) Reinsert AC Converter in DVM.

5.47 KILOHM RANGE CALIBRATION

(a) Set FUNCTION switch to KILOHMS. Place Ohms Converter board on extender.

(b) Short the following terminals together: +SIGNAL, -SIGNAL, and -OHMS CURRENT SOURCE.

(c) Adjust Voltage Zero potentiometer for zero display on DVM.

(d) Remove short between +SIGNAL and -SIGNAL and insert 10 Megohm resistor between +SIGNAL and -SIGNAL.

(e) Adjust Current Zero potentiometer for zero display on DVM.

(f) Connect the input to a 10 megohm standard and adjust the range potentiometer for a DVM Readout display equal to the value of the standard.

(g) Repeat with standard resistors near full scale of the remaining four ranges, adjusting the appropriate controls on the ohms board for a DVM Readout display for each standard value.

5.48 FACTORY ADJUSTMENTS

5.49. Certain adjustments are considered critical and it is highly recommended that they not be disturbed. These adjustments involve, generally, the selection of FSV (factory-selected values) of components to compensate for temperature drift. It is necessary that an oven be used for these adjustments.

5.50. The adjustments considered "Factory Adjustments" are R67 on the Null Detector, R49 on Auto Polarity board, and R42 on the Control Logic board. Procedures for adjusting these controls are given in the following paragraphs.

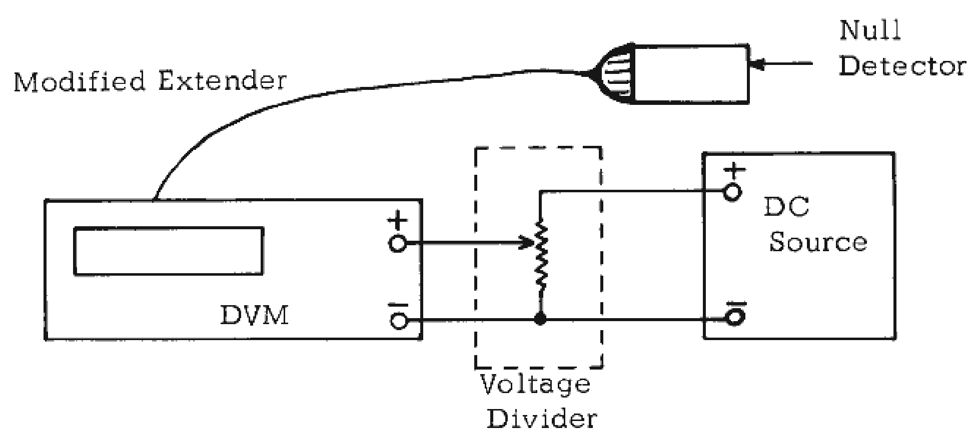


Figure 5. 9. Null Detector Tempco Adjust Set-Up

5.51 EQUIPMENT REQUIRED

Microvoltmeter, Fluke 845-AR or equivalent

Resistor Substitution Box

Precision Voltage Source

Temperature Chamber; 50°C oven

Modified Null Detector Extender (Dana)

5.52 NULL DETECTOR TEMPCO ADJUSTMENT

5.53. The following procedure need be performed only if any of the transistors in the first three stages of the Null Detector are replaced. The initial steps, prior to placing the Null Detector in the oven, should be performed at approximately 25°C. Before beginning this procedure, the Isolator Zero adjustments (paragraph 5.37) must be made.

(a) Place Null Detector on modified extender board; set DVM range to 10; remove Auto Polarity board.

(b) Remove FSV resistors R66, R68, and R69 from circuit; in place of R66, connect Resistor Substitution Box. Short null detector input to analog common.

(c) Short DVM input; set Collector Zero potentiometer R24 to center of its mechanical range. Adjust the Resistor Substitution Box for a readout of random numbers between full scale and zero. That is, adjusted to the point where the Null Detector is generating neither an Up or Down command. On either side of the optimum adjustment, the readout will be either full scale (109999) or zero (000000).

(d) Remove the Resistor Box from the circuit; in its place, install a fixed 5% carbon resistor nearest to the value determined in step c.

(e) Adjust R24 for display of random numbers between full scale and zero.

(f) Replace Auto Polarity board.

(g) Adjust voltage divider at DVM input to a voltage of -2MV (representing 20 digits).

(h) Adjust Current Zero potentiometer R7 for a readout of 000020 on DVM display.

(i) With input remaining at 20 digits, place Null Detector in temperature chamber at 50°C (by extending cable attached to modified extender board). Allow one hour warm-up.

(j) After warm-up, note number of digits displayed on DVM readout. The number of digits minus 20 represents the amount of drift. To compensate for this drift, a voltage equal to four times the amount of drift and of same polarity must be placed on the opposite base of the input pair. For example, assume that the readout drifted from 20 digits to 28 during warm-up. This means that the drift was 8 digits or 800 uV. Remove Null Detector from oven and allow to cool.

(k) To compensate for the drift, install 150 kilohms resistor across FSV terminals R69 (if drift positive) or 390 kilohms across FSV terminals R68 (if drift negative).

(l) Connect microvoltmeter to base of Q15 (base "B" on schematic). Adjust R67 for a voltage equal to four times the drift observed in step i (3.2 MV for the above example).

(m) Repeat b through H; if the drift is greater than 1 digit, add algebraicly four times the noted drift to previous results of step i and adjust the voltage in base "B" of the input dual to this value.

Example (continuing previous example):

Previous results (after temperature run):

28 digits -20 digits = 8 digits = 0.8 MV drift

0.8 MV x 4 = 3.2 MV compensation

Second temperature run (assuming readout of 18):

18 digits -20 digits = -2 digits = -0.2 MV drift

Compensation = (-0.2 MV) 4 + 3.2 MV (from first run)
-0.8 MV + 3.2 MV = 2.4 MV

5.54 AUTO POLARITY TEMPCO ADJUSTMENT

5.55. The following procedure need be performed only if the first or second stage transistor of the Auto Polarity is replaced. The initial steps, prior to placing the Auto Polarity in the oven should be performed at approximately 25°C. Before beginning this procedure, the Isolator Zero adjustments (paragraph 5.37) must be made.

(a) Place Auto Polarity board on extender board; set the DVM range to 10 and function to DC.

(b) Remove plastic cover from Auto Polarity board.

(c) Connect microvoltmeter* minus lead minus sense (pin C) and plus lead to base "B" of the input dual and adjust temperature potentiometer R49 for a microvoltmeter reading of 0 $\pm$50 uv.

(d) Remove meter lead from base B and connect to base "A" of the input dual. Replace FSV resistor R12 or R15 (a resistor is installed in one of the two) with a jumper and set potentiometer R11 to midscale.

(e) If meter reads positive, remove jumper from the FSV R12 position; if negative, remove jumper from the FSV R15 position and replace with resistor substitution box.

(f) Adjust resistor box for the meter reading nearest zero. Remove the resistor box from circuit and replace with a 5% carbon resistor of the nearest standard value determined by the resistor box setting.

(g) Adjust potentiometer R11 for a meter reading of 0 $\pm$10 uv.

*To prevent oscillations, the microvoltmeter should be "decoupled" from the amplifier circuitry by inserting in series with the positive lead, a 10K 5% carbon resistor.

(h) Remove meter leads and jumper from circuit board. Apply +2 millivolts to the input of the DVM and adjust potentiometer R7 for a DVM readout display of +20 digits (+00.0020).

(i) Set Auto Polarity board in oven at 50°C (by means of extender cable) and allow 1 hour for the board to warm-up.

(j) After warm-up, note number of digits displayed on DVM readout. The number of digits minus 20 represents the amount of drift.* Multiplying this value by 9 gives the correction factor needed for temperature compensation.

(k) Remove board from oven and allow to cool. Connect the minus lead of microvoltmeter to minus sense and the plus lead to base "B" of the input dual.

(l) Adjust potentiometer R49 for a microvoltmeter reading of the correction factor calculated in step k. Remove 2-millivolt input.

(m) Repeat steps d through k; if drift is greater than one digit, add algebraically 9 times the noted drift to the previous correction factor and adjust the voltage in base "B" of the input dual to this value. For example: Assume the DVM readout display increases from +00.0020 to +00.0023, or an increase of 3 digits (+300 uv). The correction factor is found by multiplying the 3 digits by 9, equalling a correction factor of 27, or 2.7 millivolts. On the second trial, assume the DVM readout display decreases from 00.0020 to 00.0018, or -2 digits. -2 times 9 equals -18, or -1.8 millivolts; added algebraically to 2.7 millivolts, it results in a new correction factor of 0.9 millivolts.

5.56 DISPLAY RATE ADJUSTMENT

5.57. The display rate circuitry determines the number of measurements taken by the DVM in a given time period. Readjustment of the display rate control is required only if repairs are made on this circuitry.

(a) With an oscilloscope monitor test point 2 (white) on the control logic board.

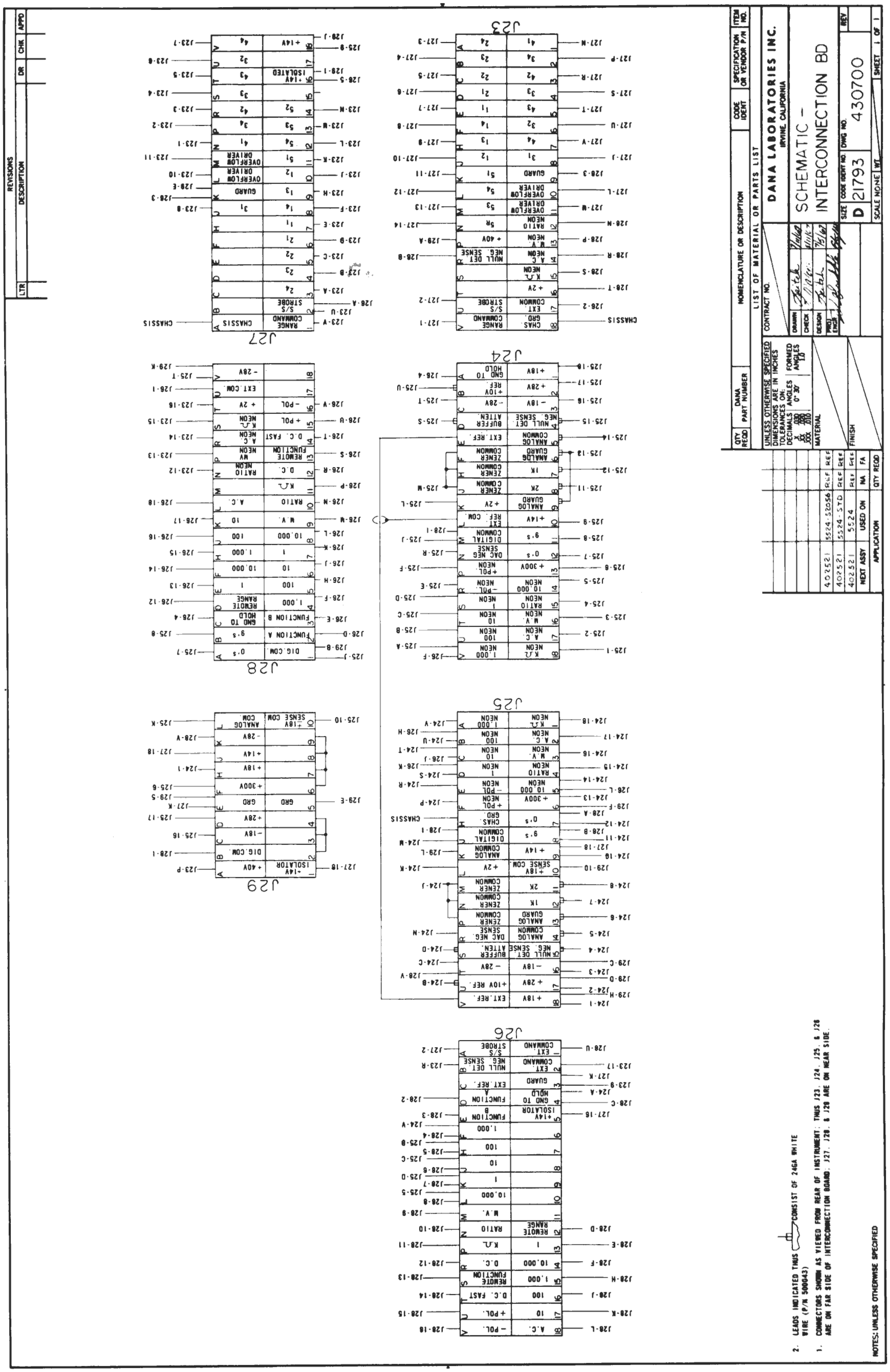
(b) Adjust potentiometer R42 on the control logic board for a pulse repetition rate of four per second.

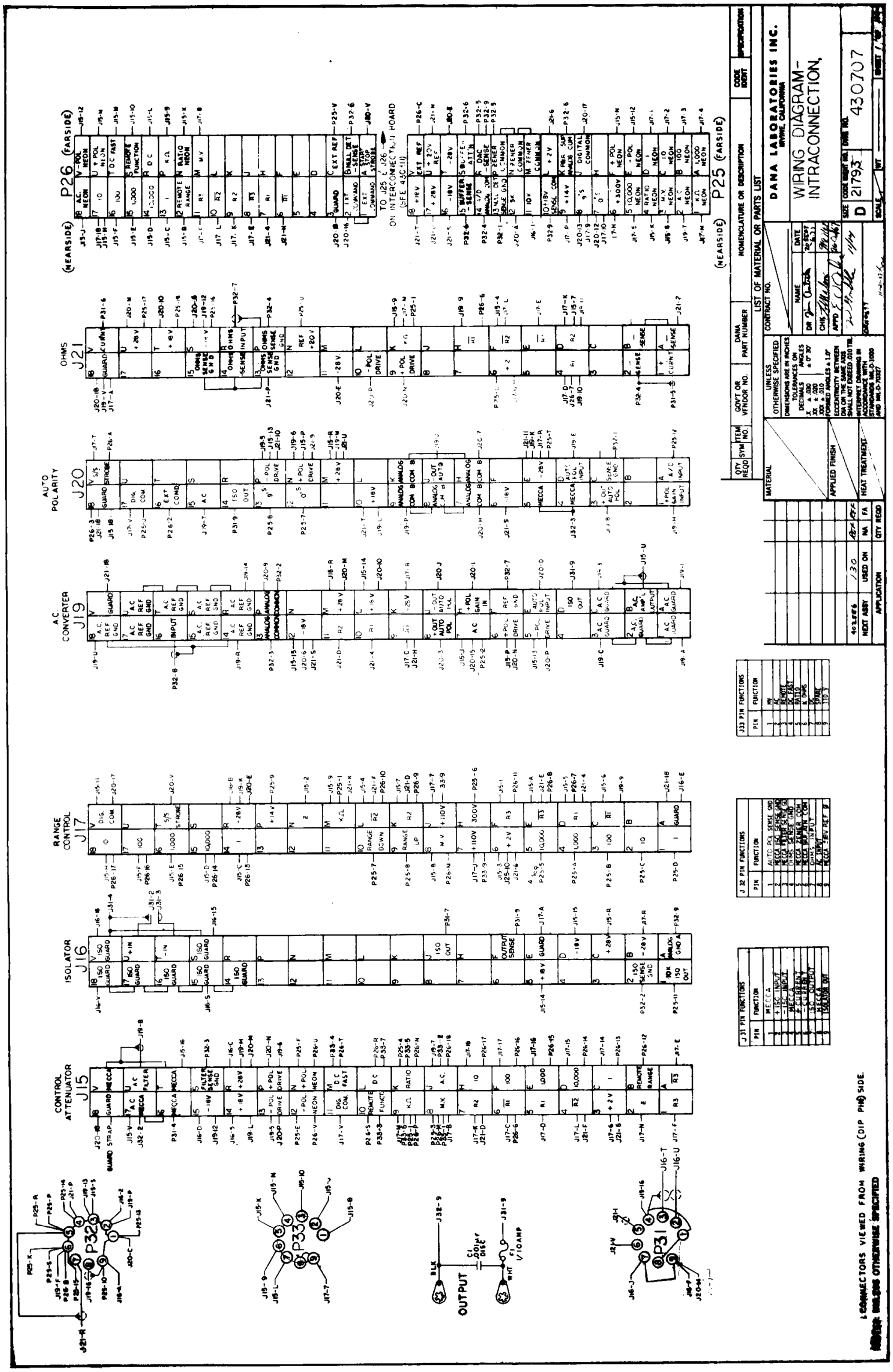
*If the amount of drift exceeds 5 digits, the matched set of gain resistors consisting of R1, R8, and R10 must be replaced.

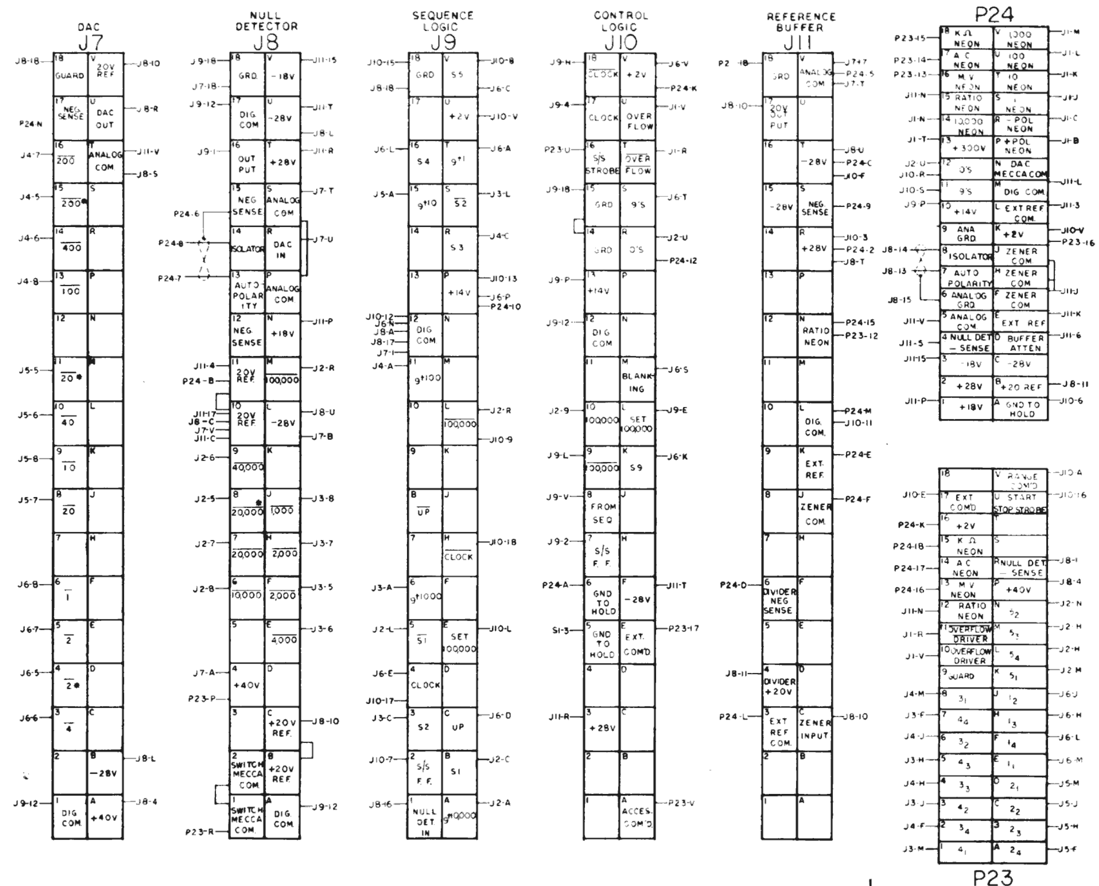
SECTION 6

DRAWINGS

6.1 DRAWINGS


DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC - INTERCONNECTION BD
D 21793 430700
J23
J24
J25
J26
J27
J28
J29


DANA LABORATORIES INC.
WIRING DIAGRAM-INTRACONNECTION,
430707
CONTROL ATTENUATOR J15
ISOLATOR J16
RANGE CONTROL J17
A.C. CONVERTER J19
AUTO POLARITY J20
OHMS J21
P26 (FARSIDE)
P25 (FARSIDE)
OUTPUT



1. CONNECTORS VIEWED FROM WIRING (DIP PIN) SIDE.

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
4°2504	5500		

APPLICATION — QTY REQD

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS | ANGLES
.X ± .030 | ± 0° 30'
.XX ± .020
.XXX ± .010
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

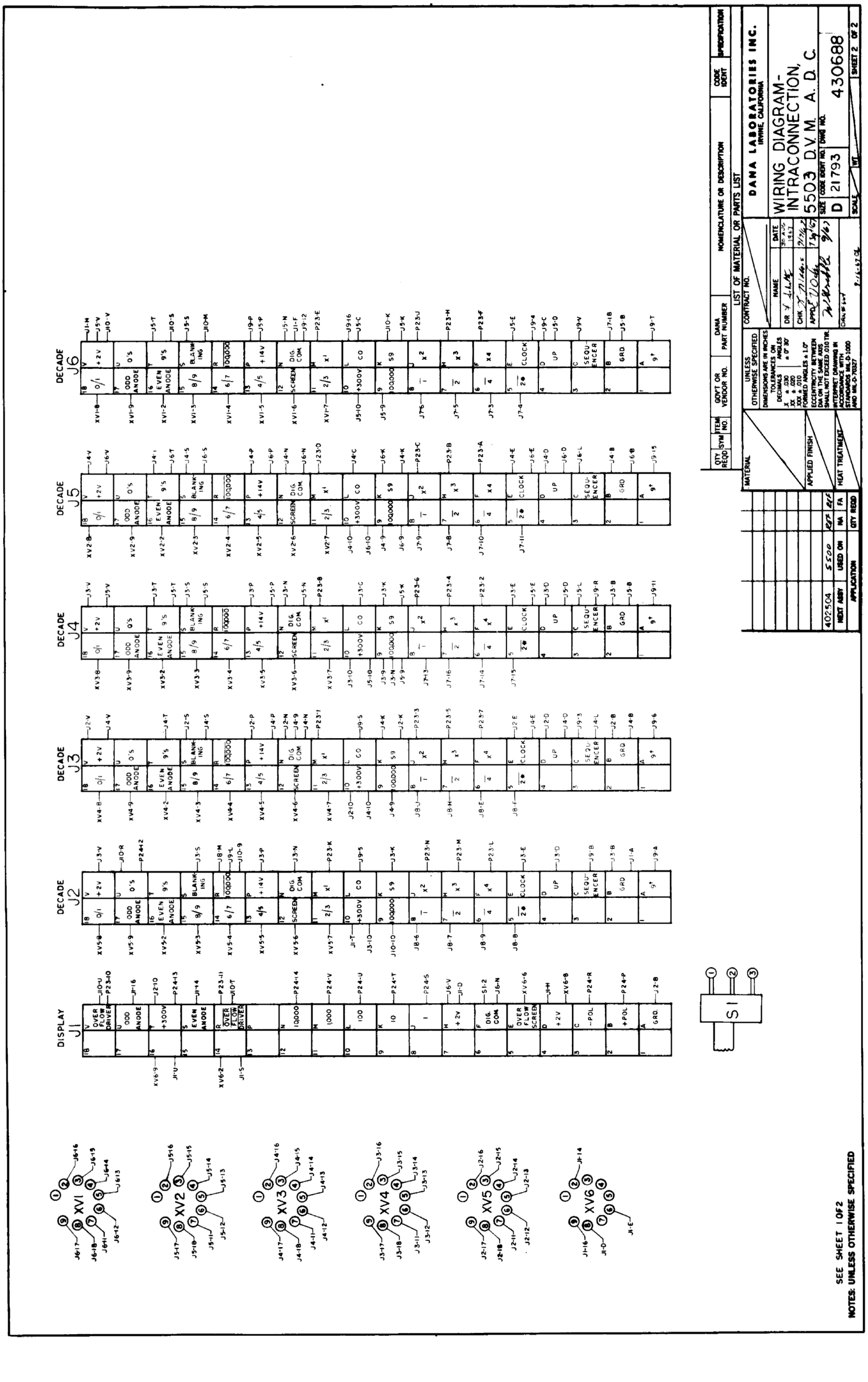
	NAME	DATE
DR		30 AUG 1967
CHK		
APP'D		7 Sept 67

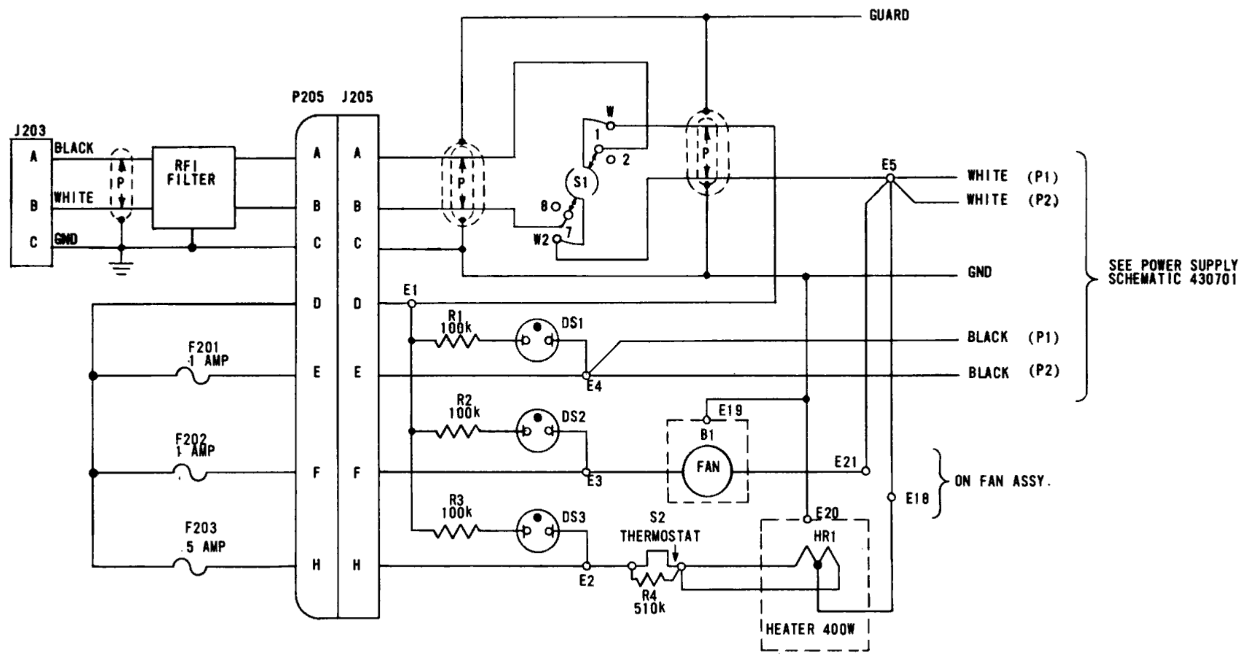
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

WIRING DIAGRAM-
INTRACONNECTION,
5503 D.V.M. A.D.C.

SIZE	CODE IDENT NO.	DWG NO.
D	21793	430688

SCALE | WT | SHEET 1 OF 2


DANA LABORATORIES INC.
IRVINE, CALIFORNIA
WIRING DIAGRAM-
INTRACONNECTION,
5503 D.V.M. A. D. C.
D 21793 430688
SHEET 2 OF 2
LIST OF MATERIAL OR PARTS LIST
402504 5500
NOTES: UNLESS OTHERWISE SPECIFIED
SEE SHEET 1 OF 2
DISPLAY J1
DECADE J2
DECADE J3
DECADE J4
DECADE J5
DECADE J6
XV1
XV2
XV3
XV4
XV5
XV6
S1



1. ALL RESISTORS ARE IN OHMS 1/4W. ± 5%. CARBON

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
402691	5524-S2056	REF	REF
402691	5524-STD	REF	REF
402541	5524	REF	REF

APPLICATION | QTY REQD

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS .X .030 .XX .020 .XXX .010 | ANGLES 0° 30' | FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

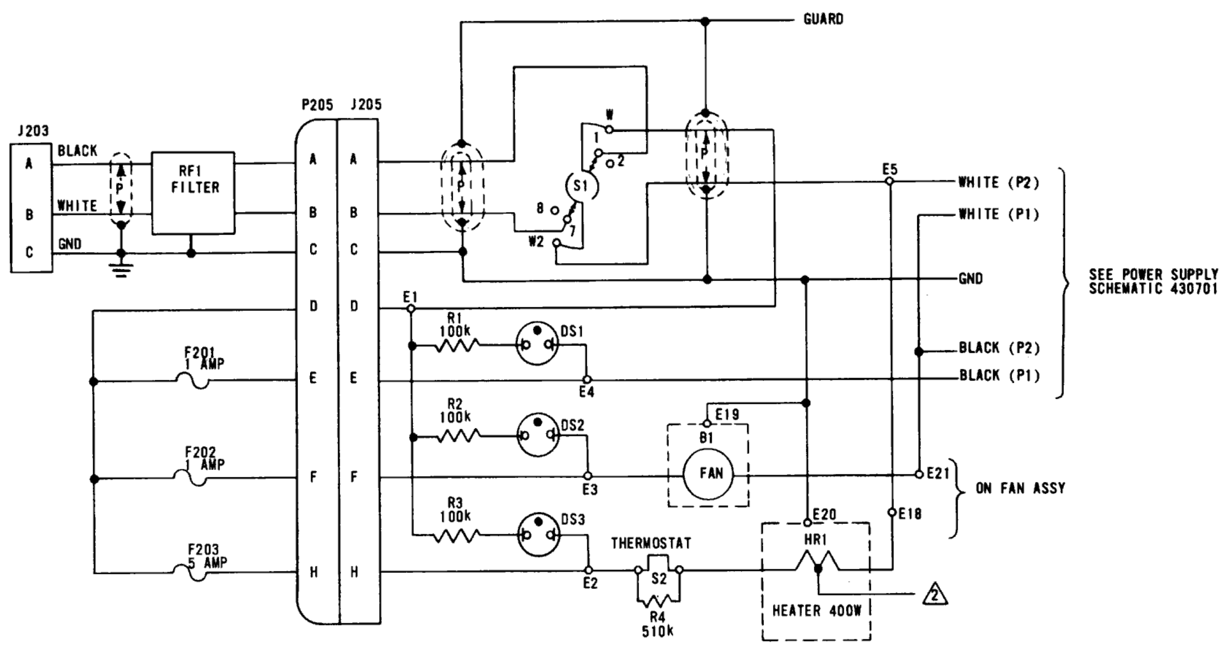
DRAWN	A. F. J.	7 AUG 1967
CHECK	[illegible]	1/15/68
DESIGN	[illegible]	1 DEC 1967
PROJ ENGR	[illegible]	1/15

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC — PRIMARY WIRING, 115V

SIZE	CODE IDENT NO.	DWG NO.	REV
C	21793	430698	

SCALE NONE | WT | SHEET 1 OF 1



NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE IN OHMS, 1/4W, CARBON, ± 5%

2. SEE FAN ASSY 402548 FOR WIRE ROUTING

NEXT ASSY	USED ON	NA	FA
402691	5524-S2056	REF	REF
402604	5524-STD	REF	REF
402541	5524	REF	REF
APPLICATION		QTY REQD	

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS .X .030 .XX .020 .XXX .010 | ANGLES 0° 30' | FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

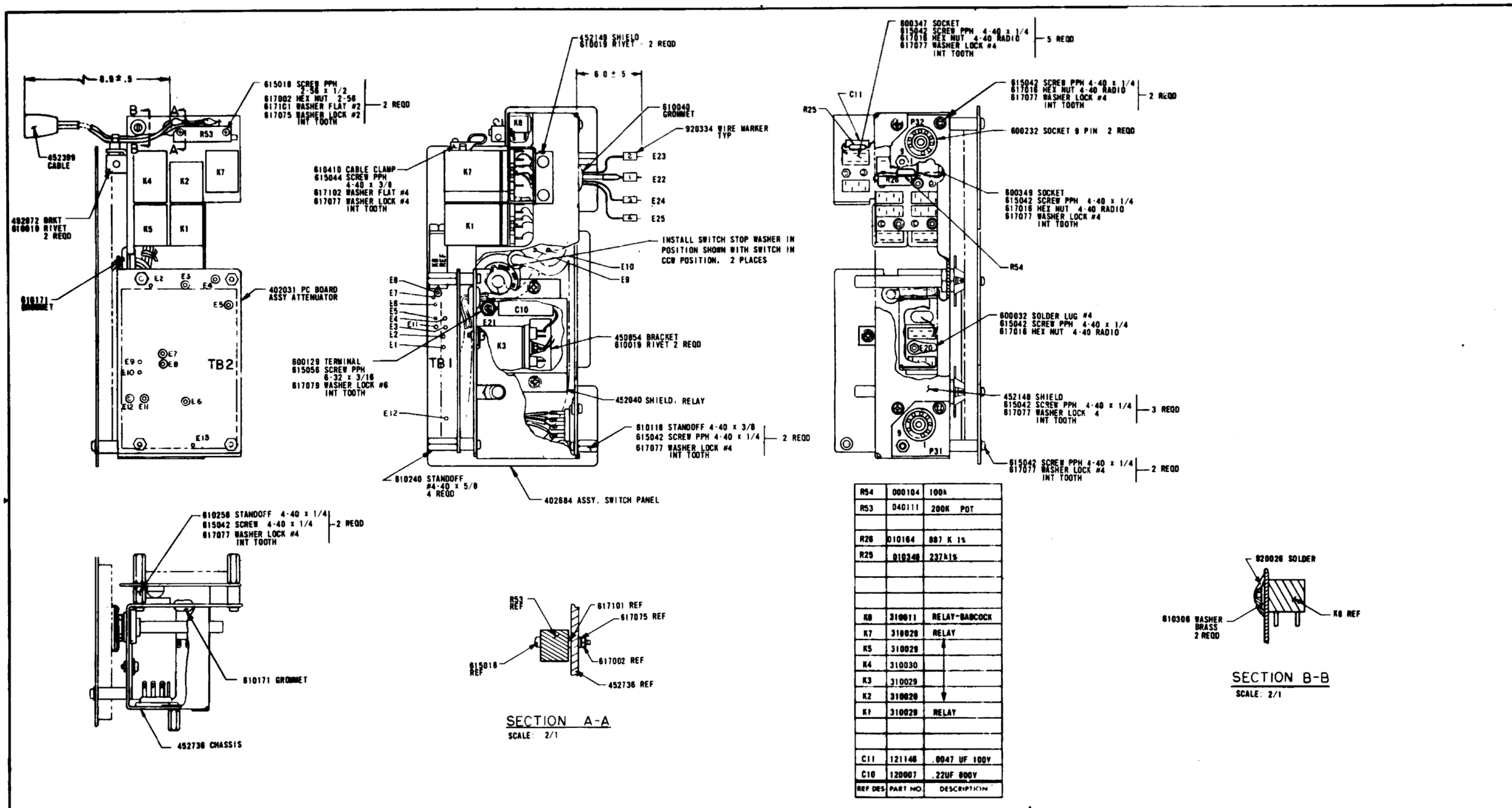
DRAWN	W. Wright	1-3-68
CHECK	A. Malone	1/15/68
DESIGN	J. Money	10 JAN 1968
PROJ ENGR	W. Siddell	1/15

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC –
PRIMARY WIRING, 230V

SIZE	CODE IDENT NO.	DWG NO.	REV
C	21793	430759	

SCALE NONE | WT | SHEET 1 OF 1



R54	000104	100k
R53	040111	200K POT
R26	010164	887 K 1%
R25	010348	237k1%
K8	310011	RELAY-BABCOCK
K7	310029	RELAY
K5	310029	
K4	310030	
K3	310029	
K2	310029	
K1	310029	RELAY
C11	121148	.0047 UF 100V
C10	120007	.22UF 800V
REF DES	PART NO.	DESCRIPTION

NOTES: UNLESS OTHERWISE SPECIFIED

1. SCHEMATIC REFERENCE. 430705A
2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS.
3. REFERENCE. WIRE LIST 430715

NEXT ASSY	USED ON	NA	FA
402689	5524-S2056	1	1
402698	5524-STD	1	1
402530	5524	1	1

APPLICATION — QTY REQD

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X .030 .XX .020 .XXX .010 ANGLES 0° 30' FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

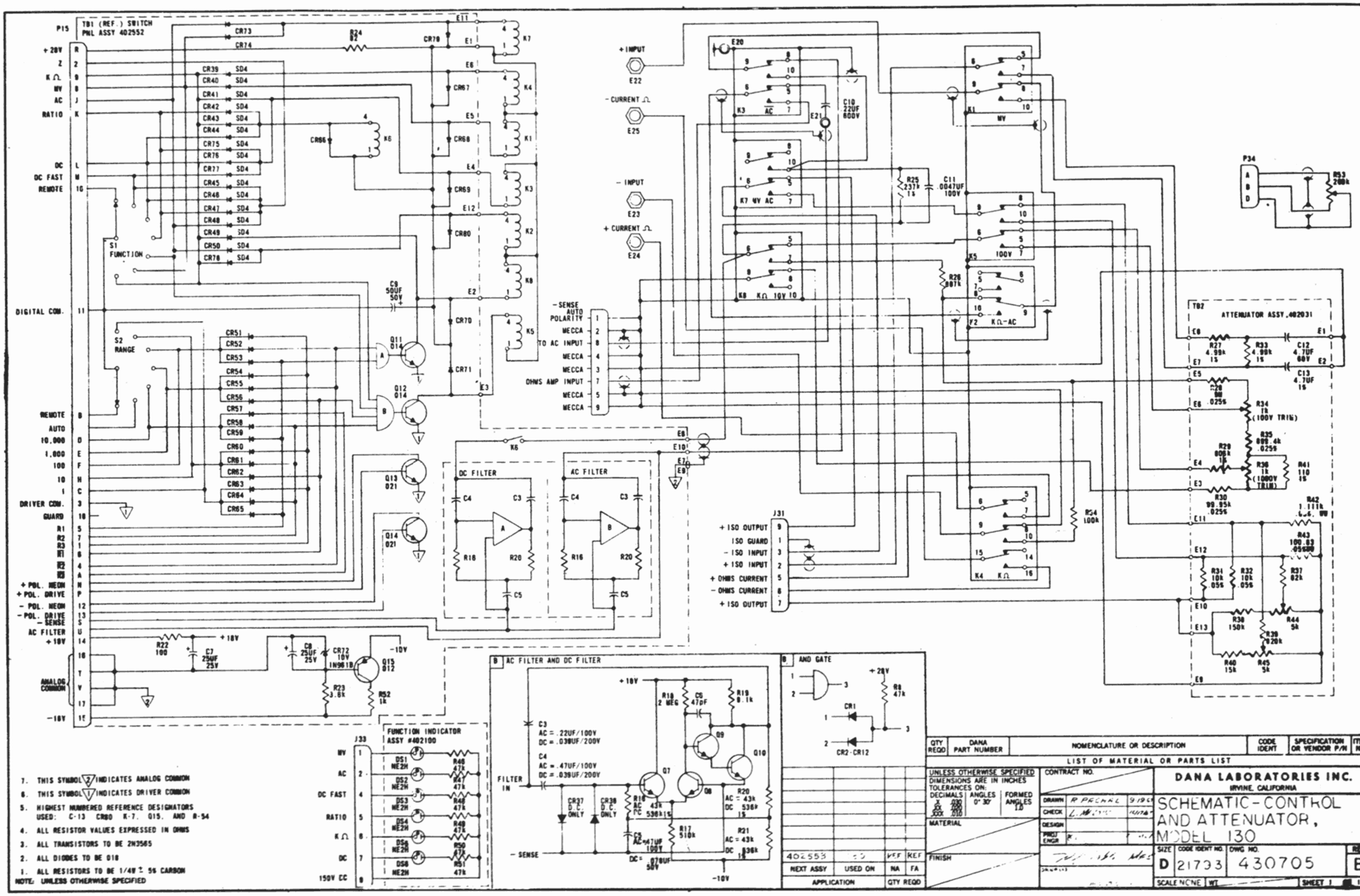
DRAWN 4 JAN 1968
CHECK J. Mynaug 5 FEB 1968
COG. ENGR
PROJ ENGR

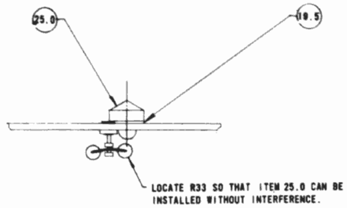
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

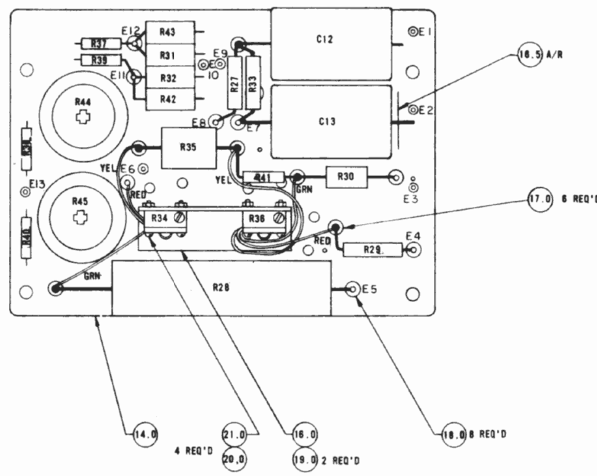
ASSEMBLY -
CONTROL & ATTENUATOR

SIZE D CODE IDENT NO. 21793 DWG NO. 402538

SCALE: 1/1 WT SHEET 1 OF 1


DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC-CONTROL AND ATTENUATOR, MODEL 130
LIST OF MATERIAL OR PARTS LIST
D 21733 430705 B
ATTENUATOR ASSY. 402031
TB1 (REF.) SWITCH PNL ASSY 402552
FUNCTION INDICATOR ASSY #402100
AC FILTER AND DC FILTER
AND GATE
DC FILTER
AC FILTER
7. THIS SYMBOL 2 INDICATES ANALOG COMMON
6. THIS SYMBOL 1 INDICATES DRIVER COMMON
5. HIGHEST NUMBERED REFERENCE DESIGNATORS USED: C-13 CR80 K-7. Q15. AND R-54
4. ALL RESISTOR VALUES EXPRESSED IN OHMS
3. ALL TRANSISTORS TO BE 2N3565
2. ALL DIODES TO BE D18
1. ALL RESISTORS TO BE 1/4W ± 5% CARBON
NOTE: UNLESS OTHERWISE SPECIFIED





REF DES	B/M ITEM	DESCRIPTION
R45	12.0	5 K POT
R44	12.0	5 K POT
R43	8.0	100.83 OHMS
R42	9.0	1.1111 K
R41	5.5	110 OHMS 1%
R40	1.0	15 K
R39	4.0	820 K
R38	2.0	150 K
R37	3.0	82 K
R36	11.0	1 K POT
R35	7.0	899.4 K
R34	11.0	1 K POT
R33	5.0	4.99 K
R32	10.0	10 K .05%
R31	10.0	10 K .05%
R30	7.0	99.95 K
R29	8.0	909 K 1%
R28	7.0	9 MEG .025%
R27	5.0	4.99 K 1%
C13	13.0	4.7 UF 63 V
C12	13.0	4.7 UF 63 V

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
14.0	410331 A
16.0	452041
16.5	500004
17.0	600030
18.0	600243
19.0	610019
19.5	610080
20.0	615129
21.0	617001
25.0	920033

3. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.
2. SCHEMATIC REFERENCE: 430404
1. ALL RESISTORS TO BE 1/4 W, ± 5% CARBON

NOTE: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
402033	130	1	1
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON: DECIMALS .X .030, .XX .020, .XXX .010; ANGLES 0° 30'; FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

DRAWN R PRCHAL 10/17/66
CHECK [signature] 10/25/66
COG. ENGR [signature] 10/26/66
PROJ ENGR J. Nelson 10/27/66

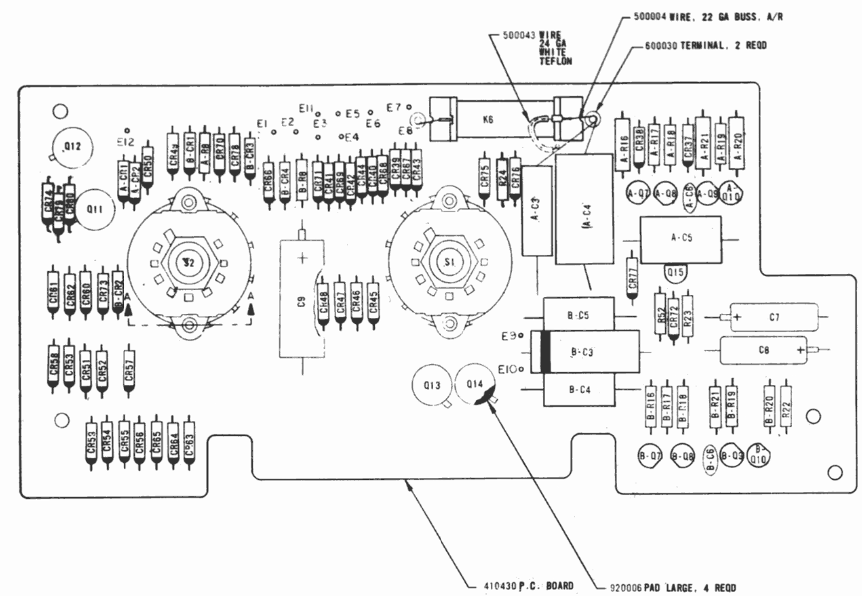
DRN # 652
8-12-67

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASSY- ATTENUATOR, 130

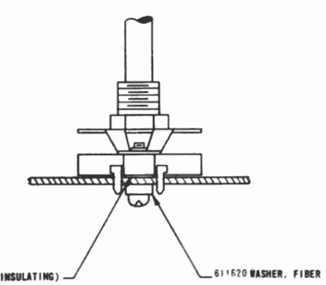
SIZE: D | CODE IDENT NO.: —— | DWG NO.: 402031 | REV: A

SCALE 2:1 | WT | SHEET 1 OF 1



SECTION A-A

TYP 4 PLACES



3 SCHEMATIC REFERENCE 430705

2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS

1. ALL RESISTORS ARE 1/4 W. ± 5% CARBON

NOTE: UNLESS OTHERWISE SPECIFIED

REF DES	PART NO.	DESCRIPTION
CR80	211083	018
CR79	211083	018
CR78	210004	SD-4
CR75	210004	SD-4
CR74	211083	018
CR73	210083	018
CR72	220004	1N961B, ZENER
CR71	211083	018
THRU		
CR51	211083	018
CR50	210004	SD-4
THRU		
CR39	210004	SD-4
CR38	211083	018
CR37		
CR4		
CR3		
CR2		
CR1	211083	018
C9	110041	50UF/50V
C8	110043	25UF 25V
C7	110043	25UF 25V
C6	101182	47PF
B-C5	120026	.47UF/100V
B-C4	120026	.47UF 100V
B-C3	121393	.22UF/100V
A-C5	120169	.078UF/50V
A-C4	120168	.039UF/200V
A-C3	120168	.039UF/200V

REF DES	PART NO.	DESCRIPTION
K6	130013A	#260-1A-24
S2	600393	7 POS POLE
S1	600394	7 POS POLE
R52	000102	1k
R24	000820	82 OHMS
R23	000362	3.6k
B-R21	000433	43k
B-R20	000433	43k
B-R19	000912	9.1k
B-R18	000205	2M
B-R17	000514	510k
B-R16	000433	43k
R22	000101	100 OHMS
A-R21	010348	536k.1%
A-R20	010348	536k.1%
A-R19	000912	9.1k
A-R18	000205	2M
A-R17	000514	510k
A-R16	010348	536k 1%
R8	000473	47k
Q15	200022	012
Q14	200079	021
Q13	200079	021
Q12	200035	014
Q11	200035	014
Q10	200043	2N3565
Q9		
Q8		
Q7	200043	2N3565

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
402538	5524-3205G	1	1
402538	5524-STD	1	1
402538	5524	1	1

APPLICATION | QTY REQD

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X ±.030 .XX ±.020 .XXX ±.010 ANGLES 0 30' FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

DRAWN J. Money 13 SEP 1968

CHECK

COG ENGR

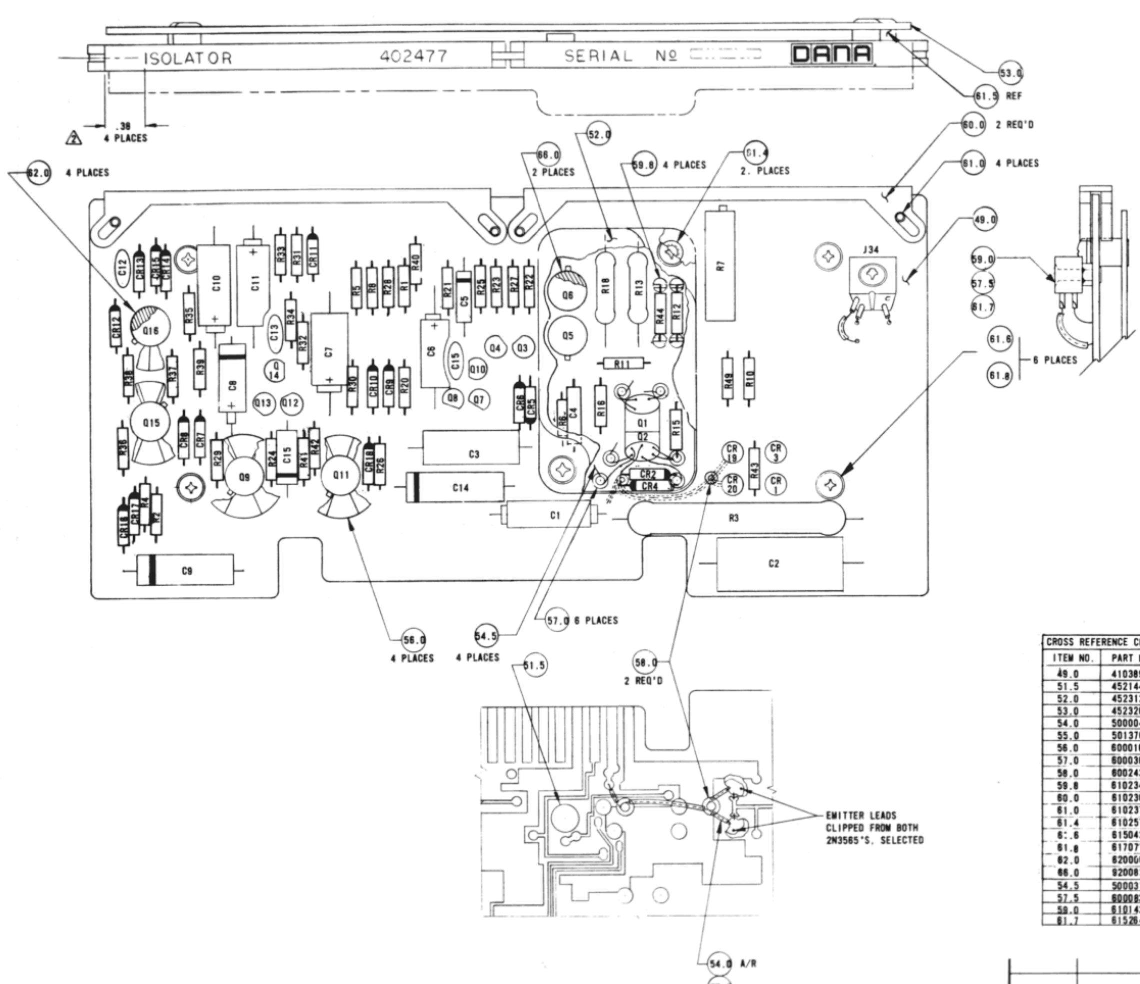
PROJ ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSEMBLY-SWITCH PANEL

SIZE D | CODE IDENT NO. 21793 | DWG NO. 402684 | REV

SCALE 2/1 | WT | SHEET 1 OF 1



CROSS REFERENCE CHART	
ITEM NO.	PART NO.
49.0	410389
51.5	452144
52.0	452312
53.0	452320
54.0	500004
55.0	501376
56.0	600016
57.0	600030
58.0	600243
59.8	610234
60.0	610236
61.0	610237
61.4	610257
61.6	615042
61.8	617077
62.0	620066
66.0	920082
54.5	500037
57.5	600083
59.0	610142
61.7	615264

REF DES	B/M ITEM	DESCRIPTION
CR16	45.5	SD4
CR15	46.0	018
	↑	↑
THRU		
	↓	↓
CR11	46.0	018
CR10	48.0	1N958B
CR9	48.0	1N958B
CR8	46.0	018
CR7	↑	↑
CR6	↓	↓
CR5	46.0	018
CR4	47.0	007
CR3	43.0	2N3565
CR2	47.0	007
CR1	43.0	2N3565
C15	28.5	.100PF DISC
C14	32.0	.1UF/100V
C13	28.5	100 pF DISC
C12	28.0	15 pF DISC
C11	29.0	25UF/50V
C10	29.0	25UF/50V
C9	32.0	.1UF/100V
C8	31.0	5UF/50V
C7	30.0	50UF/15V
C6	30.0	50UF/15V
C5	34.0	.001UF/100V
C4	36.0	.0047UF/100V
C3	35.0	2UF/100V
C2	35.5	1UF/300V
C1	35.7	.0056 UF/125V

REF DES	B/M ITEM	DESCRIPTION
R8	8.0	1.5 k
R7	25.0	10 k
R6	10.6	2.4 k
R5	17.0	6.2 k
R4	1.0	100 OHMS
R3	22.0	25 M - 2%
R2	1.0	100 OHMS
R1	8.0	1.5 k
Q16	38.0	014
Q15	38.0	014
Q14	37.0	012
Q13	41.0	2N3565
Q12	41.0	2N3565
Q11	44.0	009
Q10	37.0	012
Q9	38.0	014
Q8	41.0	2N3565
Q7	41.0	2N3565
Q6	44.5	SEL 016
Q5	44.5	SEL 016
Q4	42.0	2N3565
Q3		MATCHED PAIR
Q2	37.5	SEL 015
Q1	45.0	2N1304
CR20	43.0	2N3565
CR19	43.0	2N3565
CR18	48.5	1N4370
CR17	45.5	SD4

REF DES	B/M ITEM	DESCRIPTION
R49	18.0	75 OHMS
R44	21.3	FSV
R43	2.1	10K
R42	9.0	15 k
R41	1.0	100 OHMS
R40	13.0	43 k
R39	10.5	24 OHMS
R38	18.0	75 OHMS
R37	10.5	24 OHMS
R36	9.0	15 k
R35	14.0	510 OHMS
R34	10.8	3.3 k
R33	10.8	3.3 k
R32	21.0	9.1 k
R31	2.0	1 k
R30	21.0	9.1 k
R29	1.0	100 OHMS
R28	13.5	4.7 k
R27	2.0	1 k
R26	4.0	1.2 k
R25	2.0	1 k
R24	15.0	51 k
R23	21.0	9.1 k
R22	12.0	39 k
R21	16.0	5.6 M
R20	11.0	3.3 M
R18	21.5	10 M
R16	5.5	1.3 k
R15	17.5	6.8 M
R13	21.5	10 M
R12	21.3	FSV
R11	6.0	13 M
R10	19.0	7.5 k

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

4. SCHEMATIC REFERENCE: 430699
3. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.
2. HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO, LOCATED AS SHOWN.
1. ALL RESISTORS ARE 1/4W, ±5%, CARBON.

NOTE: UNLESS OTHERWISE SPECIFIED

NEXT ASSY	USED ON	NA	FA
402446	112	1	1
402041	130	1	1

APPLICATION — QTY REQD

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X .030 .XX .020 .XXX .010 ANGLES 0° 30' FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

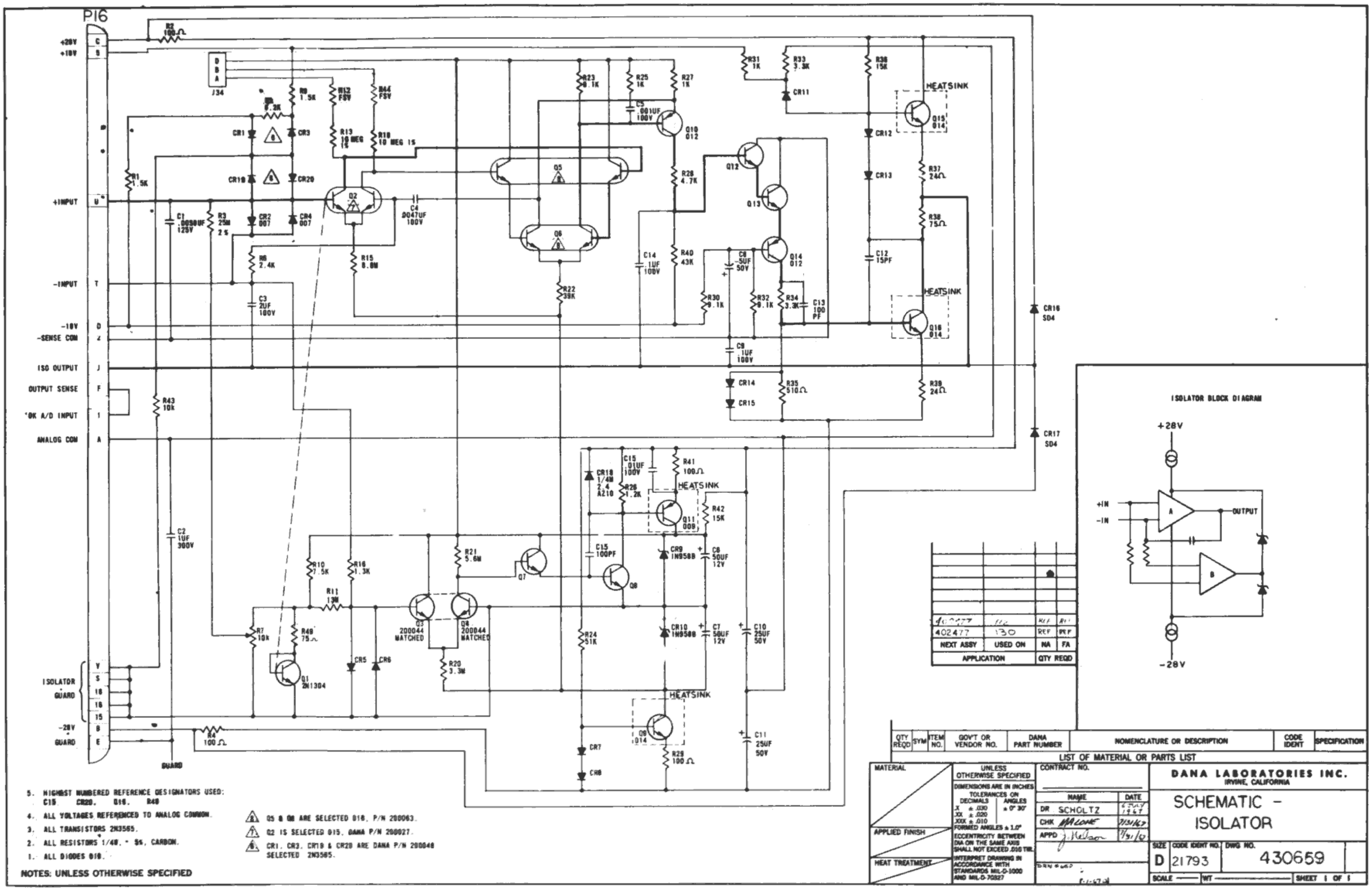
DRAWN	SCHOLTZ	7-31-67
CHECK	MALONE	7/31/67
COG. ENGR	M. CURTIS	7/31/67
PROJ. ENGR	J. Nelson	7/31/67

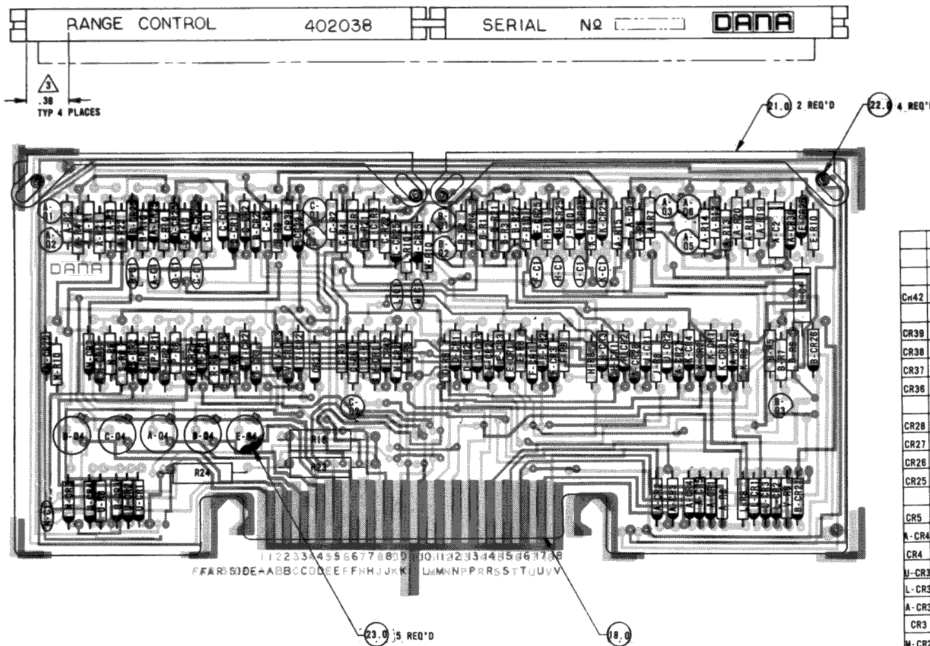
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PCB ASSY.— ISOLATOR

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	402477	

SCALE 2/1 | WT ——— | SHEET 1 OF 1


ISOLATOR BLOCK DIAGRAM
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL DIODES 010.
2. ALL RESISTORS 1/4W, ± 5%, CARBON.
3. ALL TRANSISTORS 2N3565.
4. ALL VOLTAGES REFERENCED TO ANALOG COMMON.
5. HIGHEST NUMBERED REFERENCE DESIGNATORS USED: C15 CR20, Q16, R49
Q5 & Q6 ARE SELECTED 018, P/N 200063.
Q2 IS SELECTED 015, DANA P/N 200027.
CR1, CR3, CR19 & CR20 ARE DANA P/N 200048 SELECTED 2N3565.
LIST OF MATERIAL OR PARTS LIST
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC - ISOLATOR
DR SCHOLTZ
SIZE D CODE IDENT NO. 21793 DWG NO. 430659
SHEET 1 OF 1



CROSS REFERENCE CHART	
ITEM NO.	PART NO.
18.0	410238D
21.0	610236
22.0	610237
23.0	920006

REF DES	B/M ITEM	DESCRIPTION
CR42	16.0	018
CR39	16.0	018
CR38	15.0	SD4
CR37	15.0	SD4
CR36	16.0	018
CR28	16.0	018
CR27		
CR26		
CR25	16.0	018
CR5	15.0	SD4
A-CR4	15.0	SD4
CR4	16.0	018
U-CR3	15.0	SD4
L-CR3	15.0	SD4
A-CR3	15.0	SD4
CR3	16.0	018
M-CR2	15.0	SD4
K-CR2		
J-CR2		
A-CR2	15.0	SD4
CR2	16.0	018
A-CR1	15.0	SD4
CR1	16.0	018
C2	12.0	.0022UF/100V
E-C1	12.0	.0022UF/100V
C1	10.0	.001UF DISC

REF DES	B/M ITEM	DESCRIPTION
R15	8.0	8.2 K
R14	2.0	15 K
R13	8.0	8.2 K
R12	8.0	8.2 K
R11	5.0	24 K
R10	6.0	27 K
M-R8	8.0	8.2 K
L-R8		
K-R8		
J-R8		
H-R8	8.0	8.2 K
E-R8	7.0	5.1 K
D-R8	7.0	5.1 K
C-R8	1.0	12 K
B-R8	1.0	12 K
R8	5.0	24 K
R7	3.0	200 K
R6	2.0	15 K
R5	8.0	8.2 K
R4	2.0	15 K
R3	4.0	2.2 K
R2	2.0	15 K
R1	4.0	2.2 K
Q6	14.5	2N3565
Q5	14.5	2N3565
Q4	13.0	014
Q3	14.5	2N3565
Q2	14.5	2N3565
Q1	14.5	2N3565

REF DES	B/M ITEM	DESCRIPTION
R24	9.0	130K 1W
R23	9.1	200K 1W
R22	7.0	5.1 K
R21	7.0	5.1 K
R20	.9	100 K
R19	7.0	5.1 K
R18	9.1	200k 1W

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
402041	130	1	1
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS .X ±.030 .XX ±.020 .XXX ±.010
ANGLES 0° 30'
FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

DRAWN
CHECK
COG. ENGR
PROJ ENGR

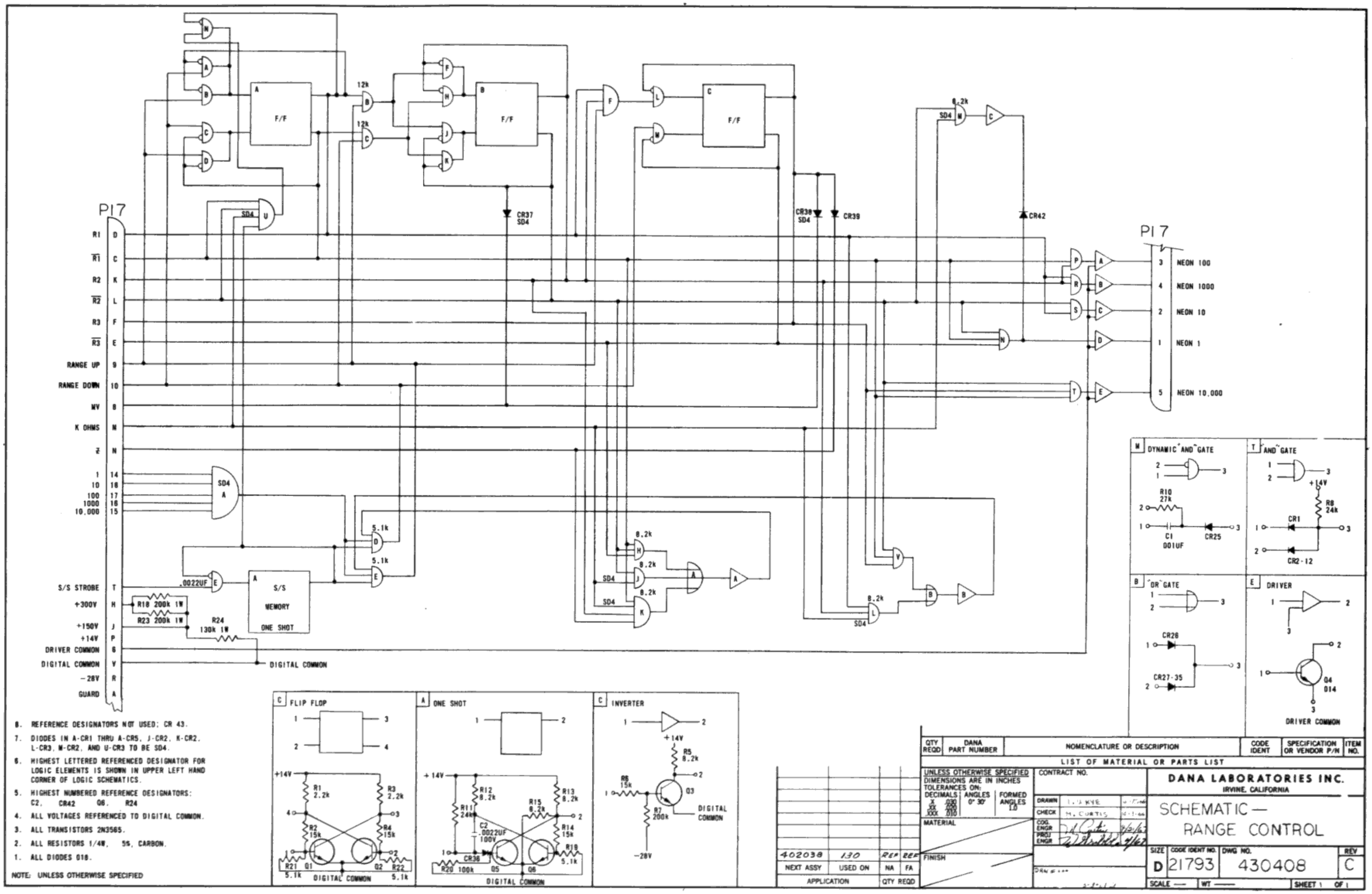
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

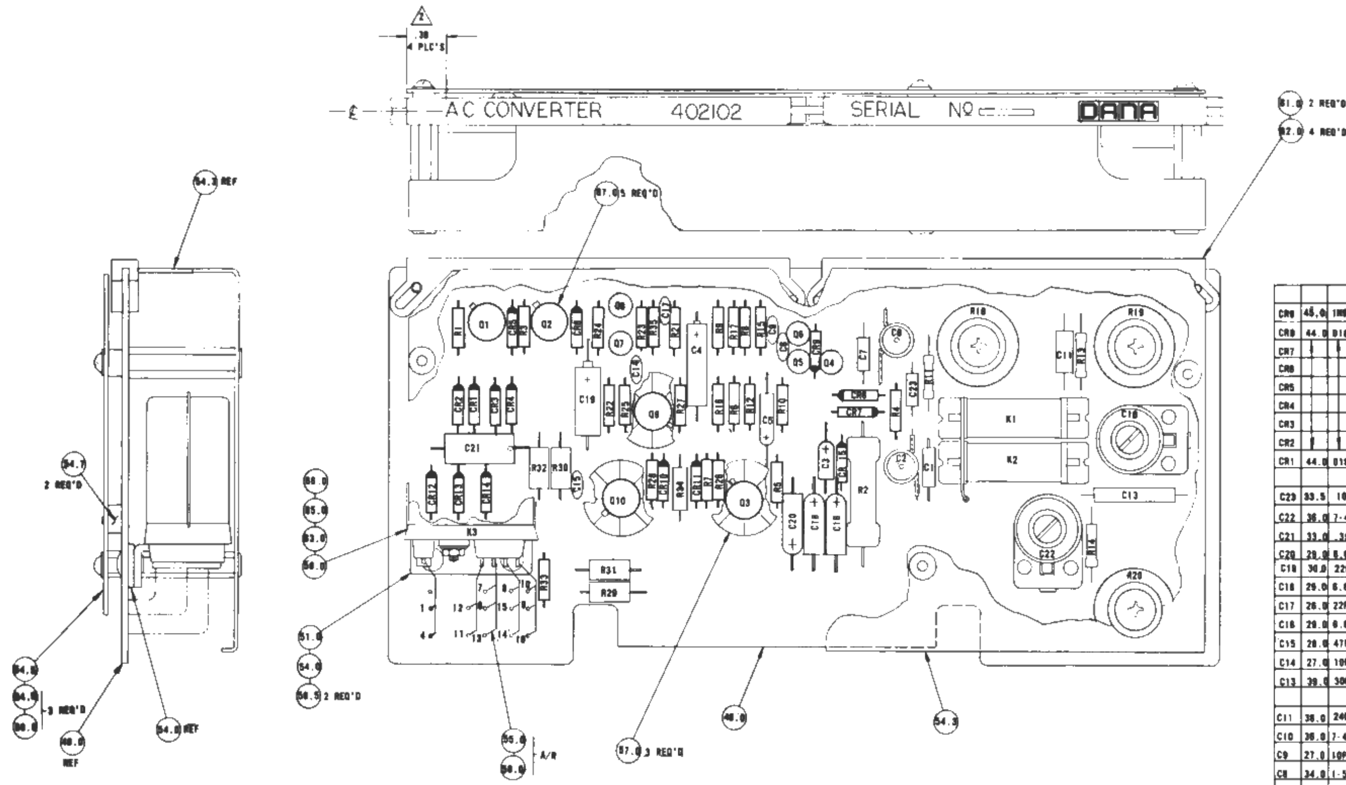
PC BOARD ASSY-
RANGE CONTROL

SIZE D | CODE IDENT NO. 21793 | DWG NO. 402038 | REV B

SCALE 2/1 | WT | SHEET 1 OF 1

4. SCHEMATIC REFERENCE: 430408
3. HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO, LOCATED AS SHOWN.
2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.
1. ALL RESISTORS ARE 1/4 W, ± 5%, CARBON.
NOTE: UNLESS OTHERWISE SPECIFIED


DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC — RANGE CONTROL
SIZE D
CODE IDENT NO. 21793
DWG NO. 430408
REV C
SHEET 1 OF 1
LIST OF MATERIAL OR PARTS LIST
QTY REQD | DANA PART NUMBER | NOMENCLATURE OR DESCRIPTION | CODE IDENT | SPECIFICATION OR VENDOR P/N | ITEM NO.
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X .030 .XX .020 .XXX .010 ANGLES 0° 30' FORMED ANGLES 1.0
MATERIAL
FINISH
CONTRACT NO.
DRAWN
CHECK
COG. ENGR
PROJ ENGR
402038 | 130 | REF | REF
NEXT ASSY | USED ON | NA | FA
APPLICATION | QTY REQD
SCALE
WT
P17
R1 D
R̄1 C
R2 K
R̄2 L
R3 F
R̄3 E
RANGE UP 9
RANGE DOWN 10
MV 8
K OHMS M
Z N
1 14
10 16
100 17
1000 18
10,000 15
S/S STROBE T
+300V H
+150V J
+14V P
DRIVER COMMON 6
DIGITAL COMMON V
-28V R
GUARD A
3 NEON 100
4 NEON 1000
2 NEON 10
1 NEON 1
5 NEON 10,000
F/F
S/S MEMORY ONE SHOT
R18 200k 1W
R23 200k 1W
R24 130k 1W
.0022UF
DIGITAL COMMON
CR37 SD4
CR38 SD4
CR39
CR42
SD4
12k
5.1k
8.2k
M DYNAMIC "AND" GATE
R10 27k
C1 .001UF
CR25
T "AND" GATE
+14V
R8 24k
CR1
CR2-12
B "OR" GATE
CR26
CR27-35
E DRIVER
Q4 018
DRIVER COMMON
C FLIP FLOP
R1 2.2k
R2 15k
R3 2.2k
R4 15k
R21 5.1k
R22 5.1k
Q1
Q2
DIGITAL COMMON
A ONE SHOT
R11 24k
R12 8.2k
R13 8.2k
R14 15k
R15 8.2k
R19 5.1k
R20 100k
C2 .0022UF 100V
CR36
Q5
Q6
C INVERTER
R5 8.2k
R6 15k
R7 200k
Q3
-28V
8. REFERENCE DESIGNATORS NOT USED: CR 43.
7. DIODES IN A-CR1 THRU A-CR5, J-CR2, K-CR2, L-CR3, M-CR2, AND U-CR3 TO BE SD4.
6. HIGHEST LETTERED REFERENCED DESIGNATOR FOR LOGIC ELEMENTS IS SHOWN IN UPPER LEFT HAND CORNER OF LOGIC SCHEMATICS.
5. HIGHEST NUMBERED REFERENCE DESIGNATORS: C2, CR42, Q6, R24
4. ALL VOLTAGES REFERENCED TO DIGITAL COMMON.
3. ALL TRANSISTORS 2N3565.
2. ALL RESISTORS 1/4W, 5%, CARBON.
1. ALL DIODES 018.
NOTE: UNLESS OTHERWISE SPECIFIED



CROSS REFERENCE CHART	
ITEM NO.	PART NO.
48.0	410250C
51.0	450854
54.0	450983
54.3	452142
54.5	452143
54.7	452144
55.0	500004
56.0	501376
57.0	600018
58.0	600222
58.5	610077
61.0	610236
62.0	610237
63.0	615042
64.0	615044
65.0	617018
66.0	617077
67.0	620000

4. SCHEMATIC REFERENCE: 430437
3. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.
2. HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO, LOCATED AS SHOWN.
1. ALL RESISTORS ARE 1/4 W. 5%, CARBON.

NOTE: UNLESS OTHERWISE SPECIFIED

REF DES	B/M ITEM	DESCRIPTION
CR9	45.0	1N981B
CR8	44.0	018
CR7		
CR6		
CR5		
CR4		
CR3		
CR2		
CR1	44.0	018
C23	33.5	10PF GLASS
C22	36.0	7-45 PF
C21	33.0	.39UF/100V
C20	29.0	6.8UF/35V
C19	30.0	22UF/35V
C18	29.0	6.8UF/35V
C17	26.0	22PF DISC
C16	29.0	6.8UF/35V
C15	28.0	470PF DISC
C14	27.0	10PF DISC
C13	39.0	3000PF GLASS
C11	38.0	240 PF GLASS
C10	36.0	7-45 PF
C9	27.0	10PF DISC
C8	34.0	1-5PF
C7	37.0	27PF GLASS
C6	28.0	470PF DISC
C5	29.0	6.8UF/35V
C4	32.0	50UF/15V
C3	31.0	1UF/35V
C2	34.0	1-5PF
C1	30.5	7.5PF

REF DES	B/M ITEM	DESCRIPTION
R10	5.0	200 OHMS
R9	7.0	2.7 K
R8	14.0	6.8 K
R7	12.0	47 OHMS
R6	18.0	91 K
R5	1.0	100 OHMS
R4	15.0	680 K
R3	13.0	47 K
R2	20.0	1 M .1% MATCH SET
R1	13.0	47 K
Q10	41.0	014
Q9	40.0	009
Q8	42.0	2N3565
Q7		
Q6		
Q5		
Q4	42.0	2N3565
Q3	41.0	014
Q2	41.0	014
Q1	41.0	014
K3	47.0	RELAY-4 POLE
K2	48.0	RELAY
K1	48.0	RELAY
CR15	44.0	018
CR14	43.0	SD-4
CR13	43.0	SD-4
CR12	43.0	SD-4
CR11	44.0	018
CR10	44.0	018

REF DES	B/M ITEM	DESCRIPTION
R35	3.0	1.5 K
R34	19.0	820 OHMS 1/2 W
R33	6.0	2 K
R32	21.0	135 K .1%
R31	21.0	135 K .1%
R30	22.0	270 K .1%
R29	22.0	270 K .1%
R28	9.0	39 OHMS
R27	17.0	91 OHMS
R26	2.0	10 K
R25	11.0	4.3 K
R24	8.0	33 OHMS
R23	16.0	750 OHMS
R22	8.0	33 OHMS
R21	4.0	15 K
R20	23.0	50 OHMS POT
R19	25.0	500 OHMS POT
R18	24.0	5 K POT
R17	10.0	3.9 K
R16	5.0	200 OHMS
R15	3.0	1.5 K
R14	20.0	3.318K .25% MATCH SET
R13	20.0	38.535K .25% MATCH SET
R12	18.0	91 K
R11	20.0	328 K .25% MATCH SET

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X .XX .XXX ANGLES 0° 30' FORMED ANGLES 1.0
MATERIAL
FINISH

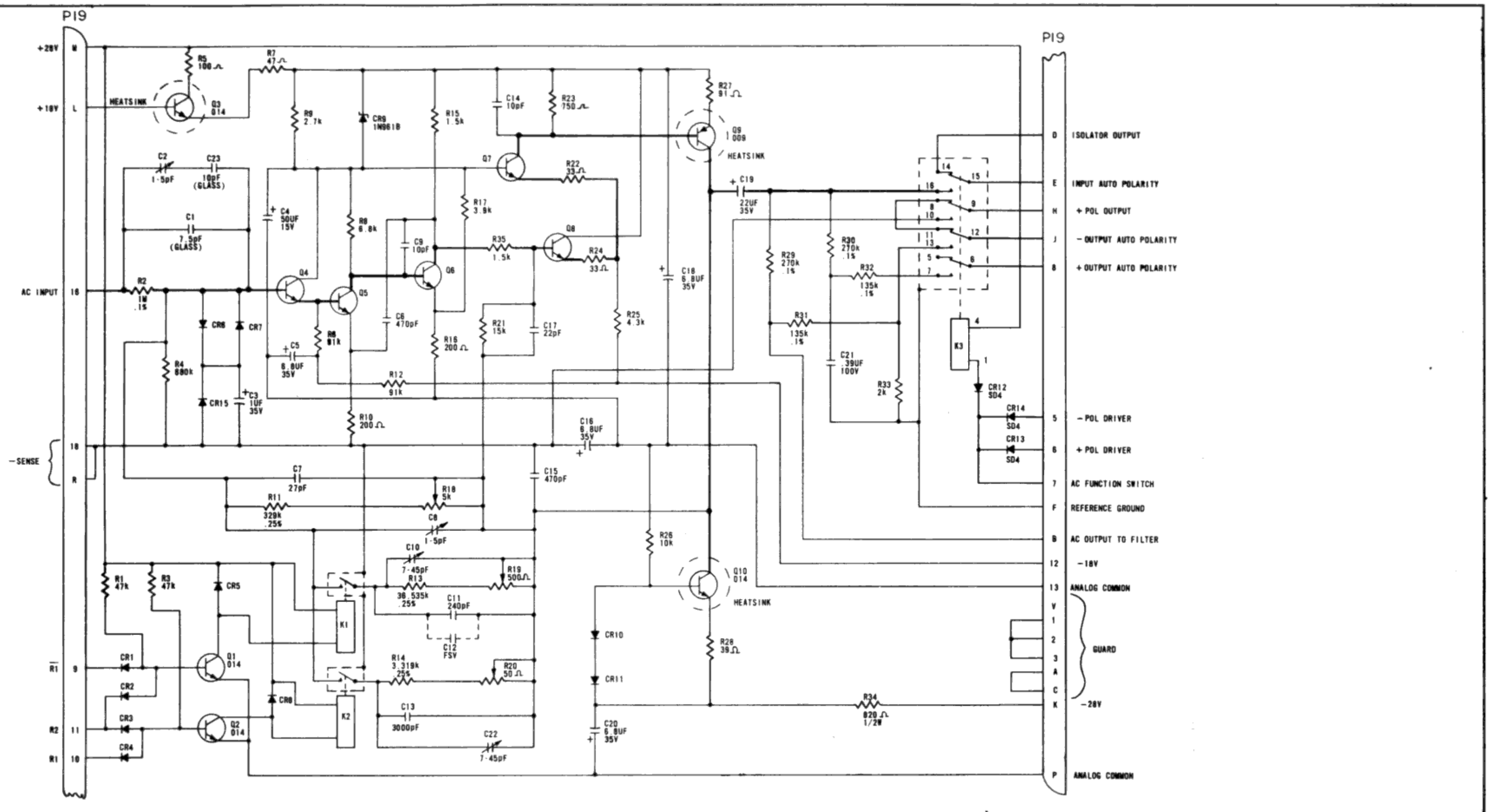
CONTRACT NO.
DRAWN ABBOTT 12-7-66
CHECK 12-18-66
COG ENGR
PROJ ENGR
9-2-67

NEXT ASSY | USED ON | NA | FA
APPLICATION | QTY REQD

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSY — AC CONVERTER

SIZE D | CODE IDENT NO. 21793 | DWG NO. 402102 | REV A
SCALE 2/1 | WT | SHEET 1 OF 1



5. HIGHEST NUMBERED REFERENCE DESIGNATORS USED: C23. CR15. K3. Q10. R35
4. ALL VOLTAGES REFERENCED TO ANALOG COMMON.
3. ALL TRANSISTORS TO BE 2N3585.
2. ALL RESISTORS TO BE 1/4W. 5%. CARBON.
1. ALL DIODES TO BE 018.

NOTE: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
402102	430(OPTIONAL)		
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X .030 .XX .020 .XXX .010 ANGLES 0° 30' FORMED ANGLES 1.5

MATERIAL

FINISH

CONTRACT NO.

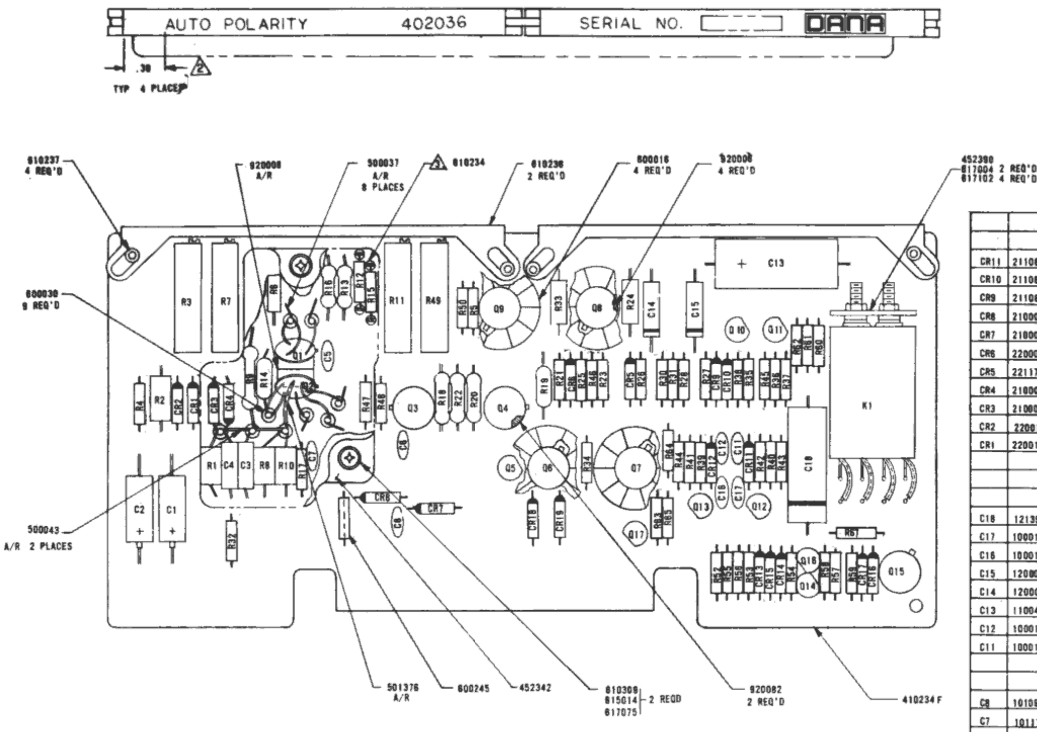
DRAWN T.E. WRYE 6-25-67
CHECK M. CURTIS 10-12-66

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC — A C CONVERTER

SIZE D | CODE IDENT NO. 21793 | DWG NO. 430437 | REV A

SCALE NONE | WT | SHEET 1 OF 1



REF DES	PART NO	DESCRIPTION
CR11	211083	018
CR10	211083	018
CR9	211083	018
CR8	210007	DHD 166
CR7	210007	DHD 166
CR6	220007	IN751
CR5	221177	1/4M 2.4 AZ10
CR4	210006	GE S388
CR3	210006	GE S388
CR2	220012	IN958B
CR1	220012	IN958B
C18	121393	.22 UF 100V
C17	100010	68pF DISC
C16	100010	68pF DISC
C15	120005	.001 UF/100V
C14	120005	.001UF /100V
C13	110044	50 UF/50V
C12	100010	68pF DISC
C11	100010	68pF DISC
C8	101099	680pF DISC
C7	101175	220 pf DISC
C6	100012	33pf
C5	101145	100pF DISC
C4	120039	24pF POLY
C3	120039	24pF POLY
C2	110039	5uf 50V
C1	110039	5uf 50V

REF DES	PART NO.	DESCRIPTION
R1	020186	10k .05%
Q17	200043	2N 3565
Q16	200049	2N3417
Q15	200035	014
Q14	200049	2N3417
Q13	200037	2N3646
Q12	200037	2N3646
Q11	200043	2N3565
Q10	200043	2N3565
Q9	200035	014
Q6	200011	009
Q7	200035	014
Q6	200011	009
Q5	200043	2N3565
Q4	200040	016
Q3	200040	016
Q2	200036	015
Q1	201084	2N1304
K1	311274	RELAY
CR19	211083	018
CR18		
CR17		
CR16		
CR15		
CR14		
CR13		
CR12	211083	018

REF DES	PART NO	DESCRIPTION
R33	001674	680 OHMS 1/2W
R32	000222	2.2k
R31	000101	100 OHMS
R30	000220	22 OHMS
R28	000220	22 OHMS
R27	000101	100 OHMS
R26	000820	82 OHMS
R25	000220	22 OHMS
R24	001712	750 Ω 1/2W
R23	000203	20k
R22	010187	442k 1%
R21	000102	1k
R20	010039	9.09k 1%
R19	010060	10k 1%
R18	010167	442k 1%
R17	000102	1k
R16	010158	200k 1%
R15	001713	FSV 1/4W 5%
R14	010282	140k 1%
R13	010158	200k 1%
R12	001713	FSV 1/4W 5%
R11	040050	5k POT
R10	020166	10k .05%
R9	010167	442K 1%
R8	020166	10k .05%
R7	040004	100k POT
R6	010079	7.5k 1%
R5	000101	100 OHMS
R4	000203	20K
R3	040050	5K POT
R2	020379	20 Ω 1% WW

REF DES	PART NO.	DESCRIPTION
R67	000222	2.2k
R65	000153	15k
R64	000163	16k
R63	000822	8.2k
R62	000202	2k
R61	000431	430 OHMS
R60	000202	2k
R59	000123	12k
R58	000153	15k
R57	000163	16k
R56	000104	100k
R55	000163	16k
R54	000273	27k
R53	000273	27k
R52	000563	56k
R50	000822	8.2 k
R49	040003	20K POT
R48	000822	8.2k
R47	000105	1MEG
R46	000102	1k
R45	000163	16K
R44	000123	12k
R43	000303	30K
R42	000822	8.2k
R41	000123	12k
R40	000303	30k
R39	000822	8.2k
R38	000153	15k
R37		
R36		
R35	000153	15k
R34	000103	10k

5. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS.
4. SCHEMATIC REFERENCE: 430406.
3. ITEM 49.0 BUS WIRE TO BE INSTALLED AT ASSY; REPLACE WITH FSV RESISTORS (ITEM 17.0) IF REQUIRED BY CHECKOUT.
2. HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO. LOCATED AS SHOWN.
1. ALL RESISTORS TO BE 1/4 W ±5% CARBON.

NOTE: UNLESS OTHERWISE SPECIFIED

402039	130	1	1
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X ±.030 .XX ±.010 .XXX ±.005 ANGLES 0° 30' FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

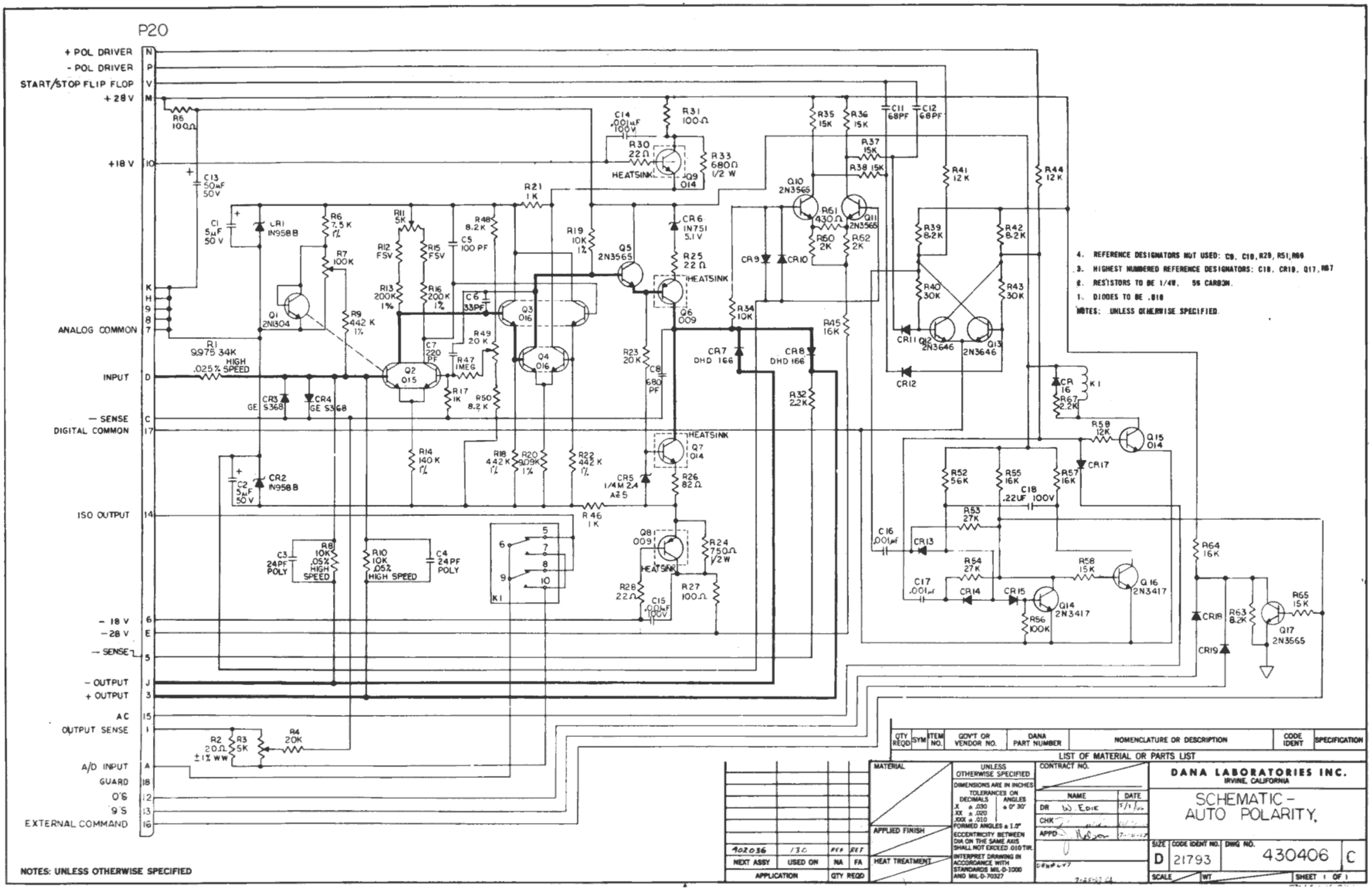
DRAWN P. PRCHAL 10-12-66
CHECK M. CURTIS 10-19-66
CSG ENGR
PROJ ENGR 7-6-67

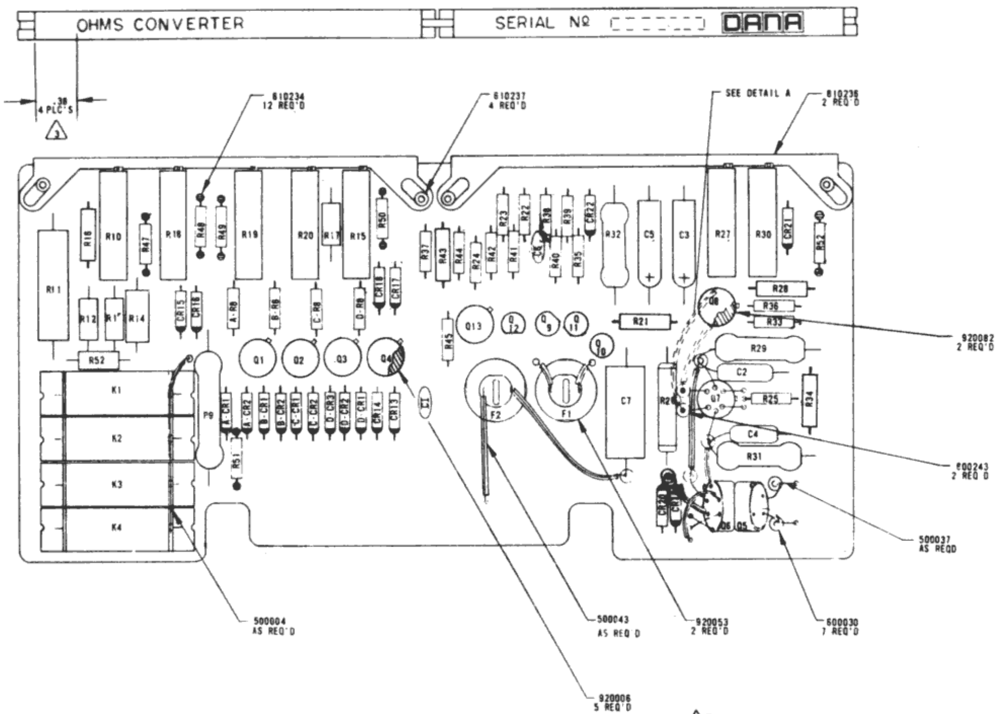
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

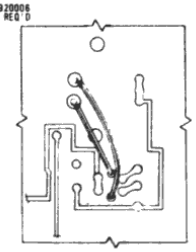
P.C. BOARD ASSY – AUTO POLARITY

SIZE D | CODE IDENT NO. 21793 | DWG NO. 402036 | REV C

SCALE 2/1 | WT | SHEET 1 OF 1


P20
+ POL DRIVER
- POL DRIVER
START/STOP FLIP FLOP
+28 V
+18 V
ANALOG COMMON
INPUT
— SENSE
DIGITAL COMMON
ISO OUTPUT
– 18 V
– 28 V
— SENSE
– OUTPUT
+ OUTPUT
AC
OUTPUT SENSE
A/D INPUT
GUARD
0'S
9'S
EXTERNAL COMMAND
4. REFERENCE DESIGNATORS NOT USED: C9, C10, R29, R51, R69
3. HIGHEST NUMBERED REFERENCE DESIGNATORS: C18, CR19, Q17, R67
2. RESISTORS TO BE 1/4W, 5% CARBON.
1. DIODES TO BE .010
NOTES: UNLESS OTHERWISE SPECIFIED.
NOTES: UNLESS OTHERWISE SPECIFIED
LIST OF MATERIAL OR PARTS LIST
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC - AUTO POLARITY,
DR W. EDIK
SIZE D
CODE IDENT NO. 21793
DWG NO. 430406 C
SHEET 1 OF 1
NEXT ASSY 402036
USED ON 130





DETAIL "A"

REF DES	PART NO	DESCRIPTION
F1	920054	0.1 AMP
CR22	221254	IN961A
CR21	221254	IN961A
CR20	211236	007
CR19	211236	007
CR18	211083	018
CR17		
CR16		
CR15	211083	018
CR14	210004	SD4
CR13	210004	SD4
CR12	211083	018
THRU		
CR1	211083	018
C7	120084	.0051UF, 100V
C6	161841	470pF, DISC
C5	110001	6.8UF, 35V
C4	121473	.0015UF, 100V
C3	1100C1	6.8UF, 35V
C2	121473	.0015UF, 100V
C1	1C1841	470pF, DISC

REF DES	PART NO	DESCRIPTION
R17	020386	10k .1%
R16	020401	10.34k .1%
R15	040004	100k POT
R14	020400	2.0088k, .1%
R13	020399	20.153k, .1%
R12	020403	201.0k, .1%
R11	010338	1 MEG, .1%
R10	000103	10k POT
R9	010339	10.104M, .1%
R8	000473	47k
Q13	200052	009
Q12	200022	012
Q11	200043	2N3565
Q10		
Q9	200043	2N3565
Q8	200040	016
Q7	200040	016
Q6	200036	015
Q5	201084	2N1304
Q4	200035	014
Q3		
Q2		
Q1	200035	014
K4	310013	RELAY
K3		
K2		
K1	310013	RELAY
F2	920280	1/64 AMP

REF DES	PART NO	DESCRIPTION
R53	001713	FSV
R52	020402	115k, .1%
R51	001713	FSV
R50		
R49		
R48		
R47	001713	FSV
R45	000101	100 Ω
R44	000332	3.3k
R43	020119	600 Ω 30,.1%
R42	000822	8.2k
R41	000202	2k
R40	000152	1.5k
R39	000473	47k
R38	000151	150 Ω
R37	000151	150 Ω
R36	000513	51k
R35	000202	2k
R34	010158	200k 1%
R33	000513	51k
R32	010236	10 MEG 1%
R31	010236	10 MEG 1%
R30	040059	1 MEG POT
R29	010236	10 MEG 1%
R28	010039	9.09k 1%
R27	040004	100k POT
R26	010139	50 MEG 2%
R25	000681	680 Ω
R24	000103	10k
R23	000511	510 Ω
R22	000432	4.3k
R21	010158	200k, 1%
R20	040055	500k POT
R19	040084	200 Ω POT
R18	040086	1k POT

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X .XX .XXX ANGLES 0° 30' FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

DRAWN / CHECK / DESIGN / PROJ ENGR

ACCESSORY	5500-130		
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

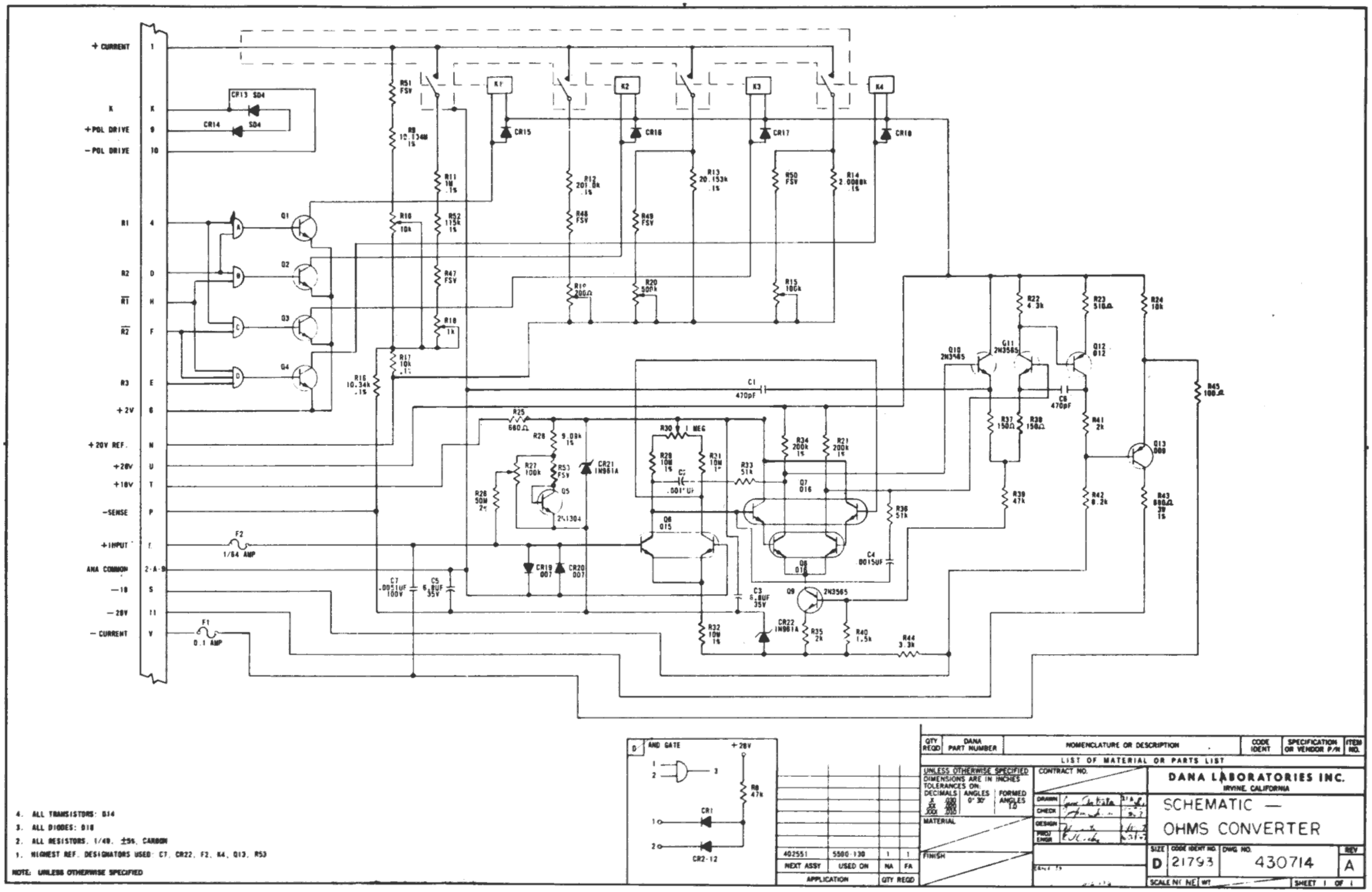
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASSY — OHMS CONVERTER

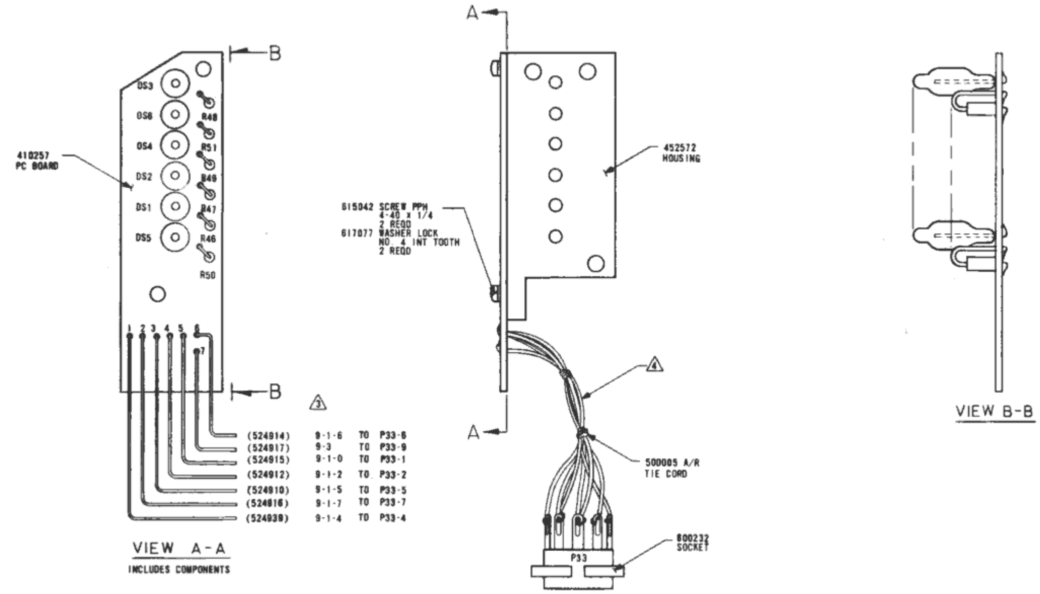
SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	402551	A

SCALE 2 : 1 | WT | SHEET 1 OF 1

5. SCHEMATIC REFERENCE: 430714.
4. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS.
3. HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO, LOCATED AS SHOWN.
2. REFERENCE DESIGNATORS NOT USED: R46
1. ALL RESISTORS TO BE 1/4W, ±5%, CARBON.
NOTE: UNLESS OTHERWISE SPECIFIED



+ CURRENT
K
+POL DRIVE
-POL DRIVE
R1
R2
R3
+2V
+20V REF.
+20V
+10V
-SENSE
+INPUT
ANA COMMON
-10
-20V
- CURRENT
F2 1/64 AMP
F1 0.1 AMP
4. ALL TRANSISTORS: 014
3. ALL DIODES: 010
2. ALL RESISTORS, 1/4W, ±5%, CARBON
1. HIGHEST REF. DESIGNATORS USED: C7, CR22, F2, K4, Q13, R53
NOTE: UNLESS OTHERWISE SPECIFIED
AND GATE
402551
5500-130
NEXT ASSY
USED ON
APPLICATION
QTY REQD
LIST OF MATERIAL OR PARTS LIST
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC —
OHMS CONVERTER
D
21793
430714
A



R51	000473	47k 1/4W
↕	↕	↕
R48	000473	47k 1/4W
DS4	920116	NEON LAMP
↕	↕	↕
DS1	920116	NEON LAMP
REF DES	PART NO.	DESCRIPTION

NOTES: UNLESS OTHERWISE SPECIFIED

5. ALL RESISTORS ARE 1/4W 5% CARBON
4. WIRES TO BE 3 1/4 INCHES LONG FROM PC BOARD TO CONNECTOR PINS
3. ALL WIRES ARE 24 GUAGE 7 STRAND
2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS
1. SCHEMATIC REFERENCE 430709

NEXT ASSY	USED ON	NA	FA
402692	5524-S2056	1	1
402537	5524-STD	1	1
402537	5524	1	1

APPLICATION — QTY REQD

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X .XX .XXX; ANGLES 0° 30'; FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

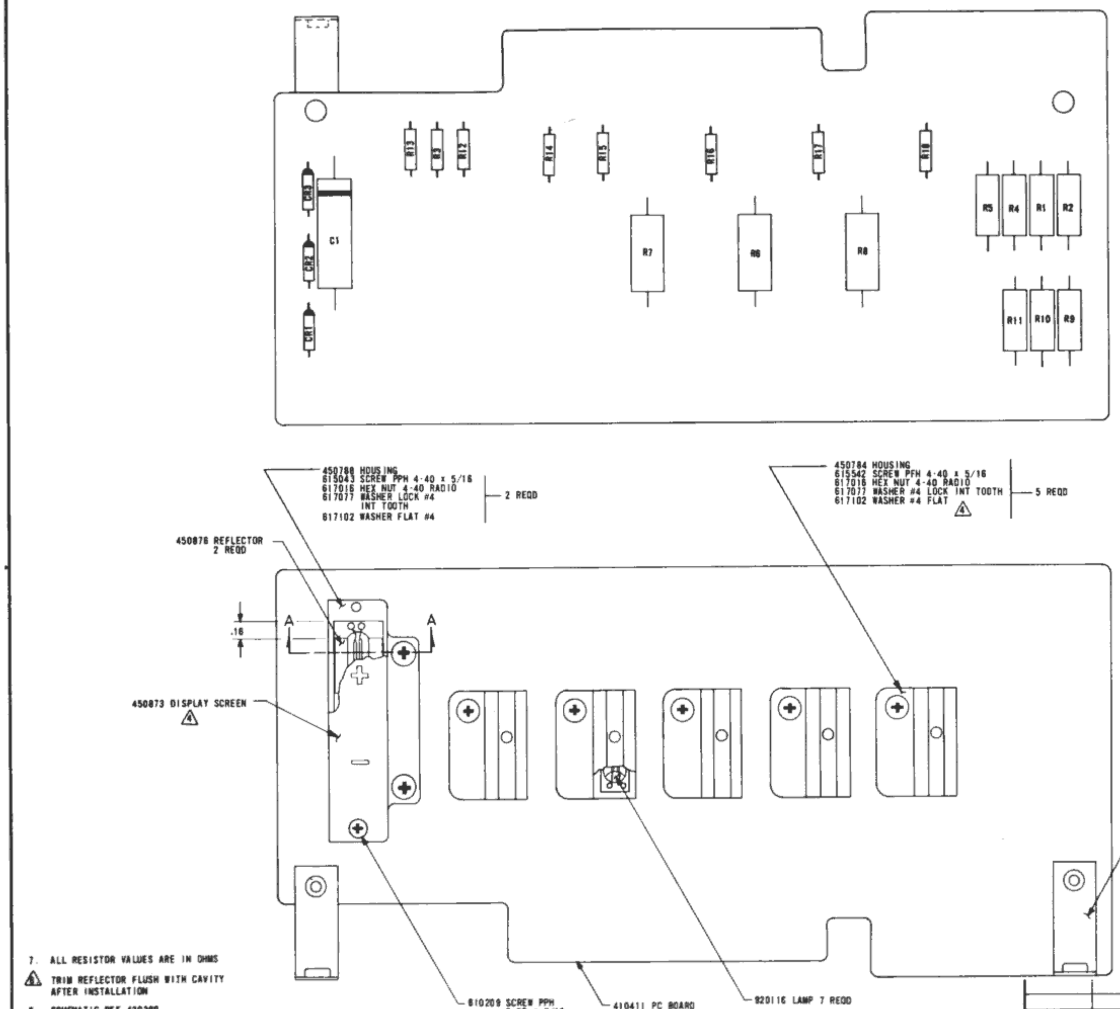
DRAWN Al Hodson 20 OCT 1967
CHECK J. Monroy 31 NOV 1967
DESIGN J. Monroy 21 NOV 1967
PROJ ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

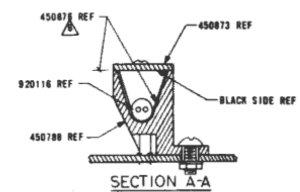
ASSEMBLY –
FUNCTION INDICATOR

SIZE D | CODE IDENT NO. 21793 | DWG NO. 402549 | REV

SCALE 2/1 | WT | SHEET 1 OF 1



REF DES	PART NO	DESCRIPTION
R18	000914	910k
R17		910k
R16		910k
R15		910k
R14		910k
R13		910k
R12	000914	910k
R11	030012	130k 1W
R10	030012	130k 1W
R9	030012	130k 1W
R8	030005	100k 2W
R7	030005	100k 2W
R6	030005	100k 2W
R5	001698	20k 1W
R4	001107	39k 1W
R3	000224	220k
R2	001698	20k 1W
R1	001107	39k 1W
CR3	210004	SD-4
CR2	210004	SD-4
CR1	210004	SD-4
C1	110041	250UF/6V



SECTION A-A

7. ALL RESISTOR VALUES ARE IN OHMS
6. TRIM REFLECTOR FLUSH WITH CAVITY AFTER INSTALLATION
5. SCHEMATIC REF 430309
4. INDICATOR TUBES AND DISPLAY SCREENS TO BE MASKED BEFORE HUMI-SEAL
3. ALL NEON LAMPS ARE NE-2H
2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS
1. ALL RESISTORS ARE CARBON 1/4W. ± 5%

NOTES: UNLESS OTHERWISE SPECIFIED

NEXT ASSY	USED ON	NA	FA
402530	5524-S2066	1	1
402530	5524-STD	1	1
402530	5524	1	1
APPLICATION		QTY REQD	

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X .030 .XX .020 .XXX .010 ANGLES 0° 30' FORMED ANGLES 1.0°

MATERIAL

FINISH

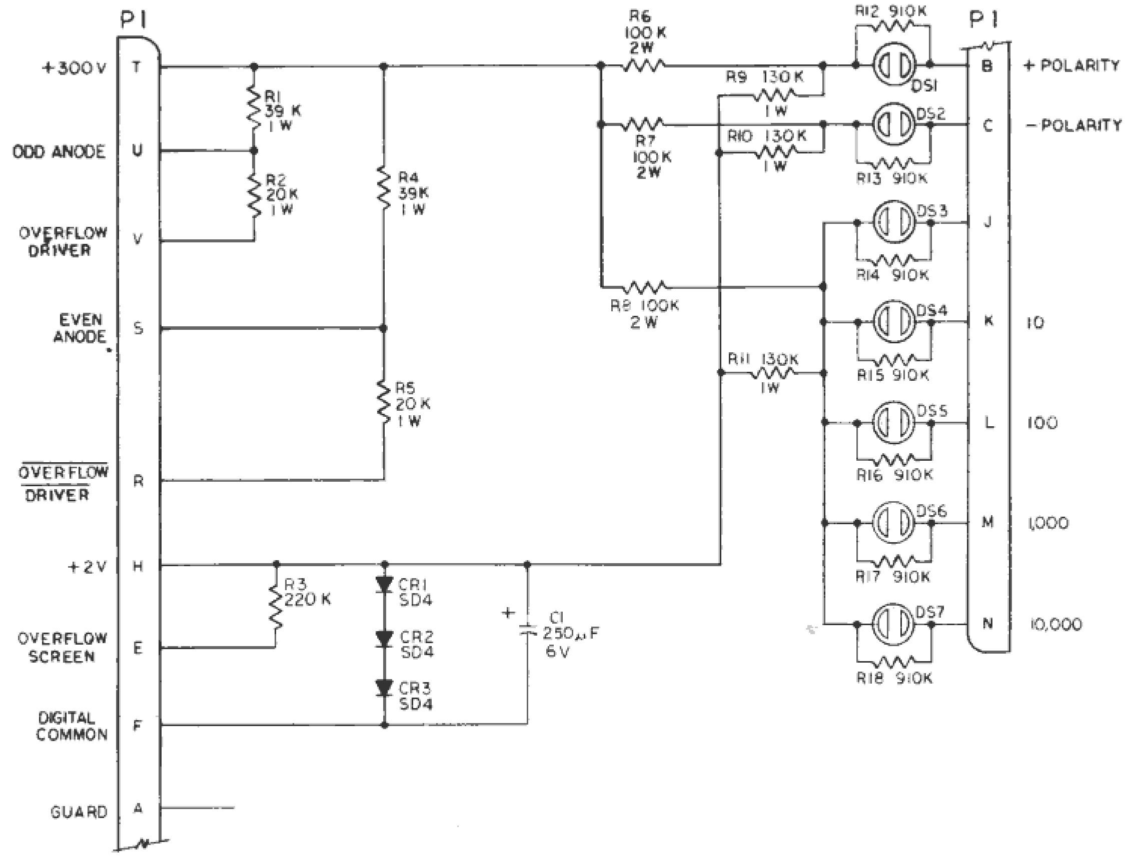
CONTRACT NO.

DRAWN: [signature] 8 JAN 68
CHECK: [signature] 1/11/68
DESIGN: [signature] 9 JAN 1968
PROJ ENGR: [signature]

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSY — DISPLAY, 5 DIGIT

SIZE D | CODE IDENT NO. 21793 | DWG NO. 402520 | REV
SCALE 2/1 | WT | SHEET 1 OF 1



NOTES: UNLESS OTHERWISE SPECIFIED

1. RESISTORS TO BE CARBON, ±5%, 1/4 W.
2. ALL NEON LAMPS ARE NE-2H
3. HIGHEST REFERENCE DESIGNATORS:
   C1 DS7
   CR3 R18
4. REFERENCE DESIGNATORS NOT USED: NONE

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

400890	5500	REF	RET
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: .X ± .030, .XX ± .020, .XXX ± .010
ANGLES: ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

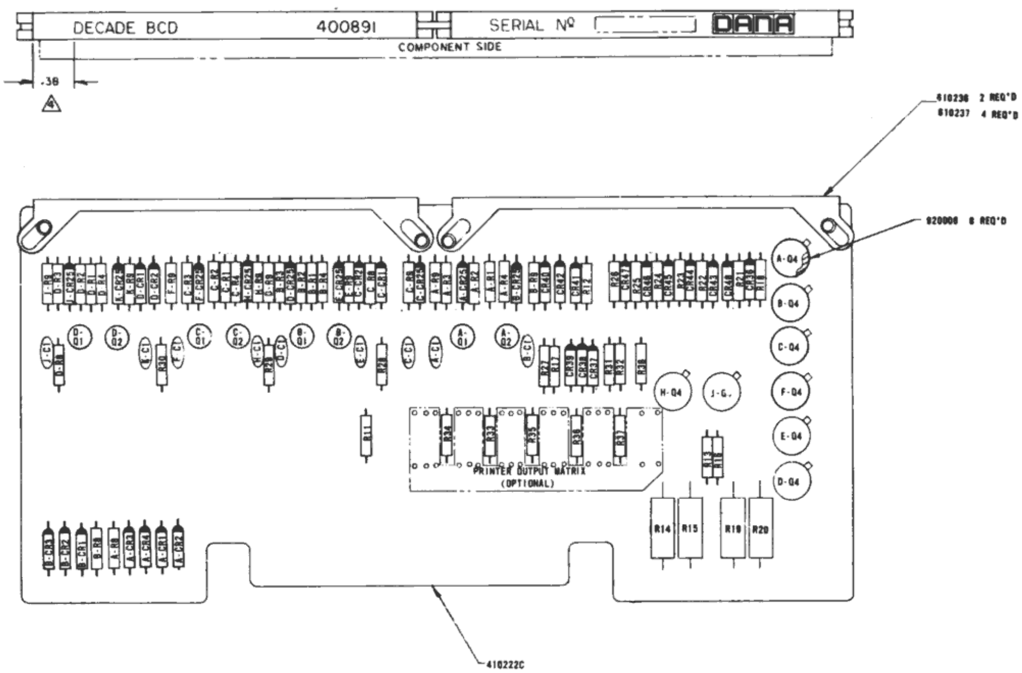
	NAME	DATE
DR	W. Edie	25 APR. 1966
CHK	[illegible]	10/7/66
APPD	[illegible]	4/67

DAN # 629
4-20-67 cl

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC – DISPLAY

SIZE	CODE IDENT NO.	DWG NO.	
C	—	430389	A
SCALE —	WT —		SHEET 1 OF 1



REF DES	PART NO.	DESCRIPTION	REF DES	PART NO.	DESCRIPTION
R16	000103	10 K			
R15	001107	39 K, 1 W			
R14	001690	20 K, 1 W			
R13	000103	10 K			
R12	000103	10 K			
R11	000204	200 K			
R9	000273	27 K			
R8	000243	24 K			
R4	000153	15 K			
R3	000122	1.2 K			
R2	000153	15 K			
R1	000122	1.2 K	R38	000204	200 K
			R37	000473	47 K
Q4	200079	0.31	THRU		
Q2	200037	2N3646			
Q1	200037	2N3646	R33	000473	47 K
			R32	000563	56 K
			R31	000683	68 K
CR48	211083	018	R30	000223	22 K
THRU			THRU		
CR36	211083	018	R27	000223	22 K
			R28	000103	10 K
CR25	211083	018			
CR4			THRU		
CR3					
CR2			R21	000103	10 K
CR1	211083	018	R20	001690	20 K, 1 W
			R19	001107	39 K, 1 W
E-C1	100005	22PF DISC	R18	000103	10 K
C1	101182	47 PF DISC	R17	000103	10 K

NEXT ASSY	USED ON	NA	FA
402269	5500 BASIC	1	5
	5400, 5403 BASIC	1	4
402357	MOD 61, P2	1	4
	73-E2, 75-E2	1	5
	63-E2, 65-E2	1	4
402342	MOD 61-P1	1	4
	73-E1, 75-E1	1	5
	63-E1, 65-E1	1	4
402343	MOD 61, M2	1	4
	73-D2, 75-D2	1	5
	63-D2, 65-D2	1	4
402162	MOD 61, M1	1	4
	73-D1, 74, 75-D1	1	5
	63-D1, 64, 65-D1	1	4
APPLICATION		QTY REQD	

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X ±.030 .XX ±.020 .XXX ±.010; ANGLES 0° 30'; FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

DRAWN ABBOTT 1/7/67
CHECK 1/16/67
CCG. ENGR
PROD ENGR J. Nelson

DEN #612 5-8-67

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

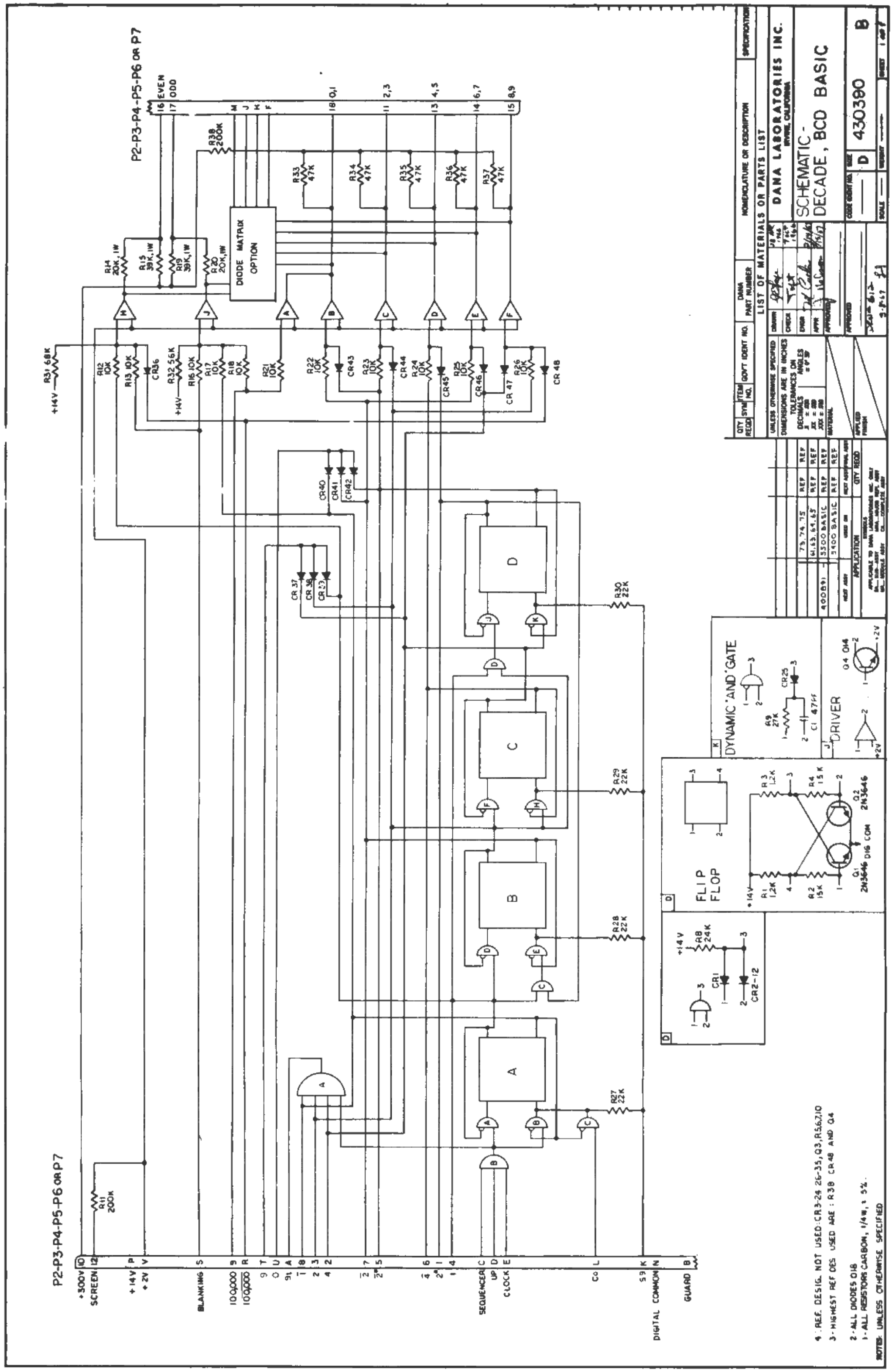
PC BOARD ASSY — DECADE, BASIC

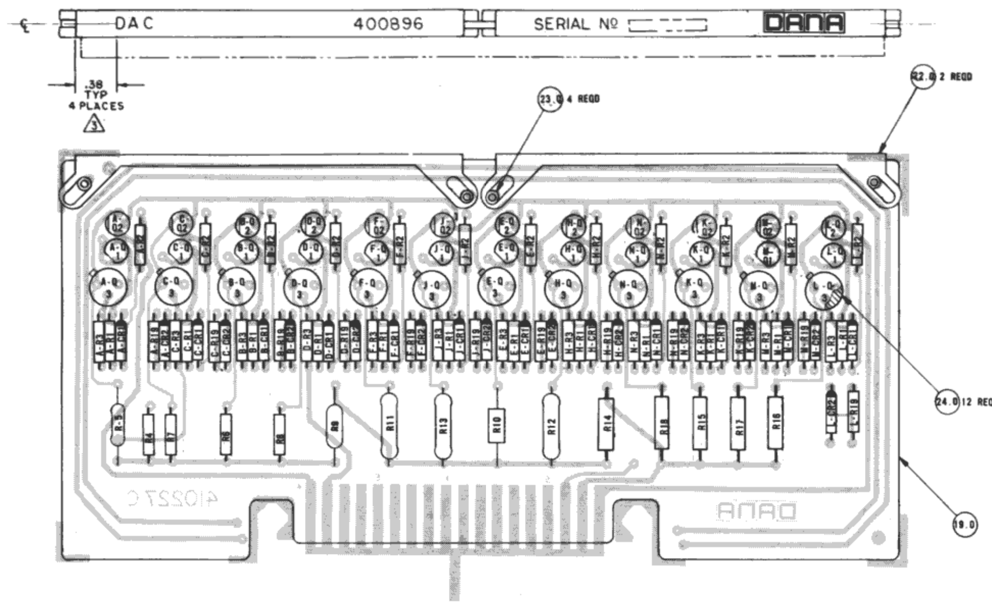
SIZE D | CODE IDENT NO. 21793 | DWG NO. 400891 | REV F

SCALE 2/1 | WT | SHEET 1 OF 1

NOTE: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE 1/4 W, ± 5%, CARBON.
2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS.
3. SCHEMATIC REFERENCE: 430390.
4. HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO, LOCATED AS SHOWN.


DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC-
DECADE, BCD BASIC
430390
LIST OF MATERIALS OR PARTS LIST
P2-P3-P4-P5-P6 OR P7
DIODE MATRIX OPTION
FLIP FLOP
DYNAMIC 'AND' GATE
DRIVER
4 - REF. DESIG. NOT USED: CR3-24 26-35, Q3, R5,6,7,10
3 - HIGHEST REF DES USED ARE: R38 CR48 AND Q4
2 - ALL DIODES D18
1 - ALL RESISTORS CARBON, 1/4 W, ± 5%.
NOTES: UNLESS OTHERWISE SPECIFIED



REF DES	B/M ITEM	DESCRIPTION
R 19	2.9	20 K
R 18	13.0	200K .05%
R 17	12.0	100K .05%
R 16	12.0	100K .05%
R 15	14.0	50 K .05%
R 14	11.0	100K .1%
R 13	9.0	200K .25%
R 12	8.0	100K .25%
R 11	8.0	100K .25%
R 10	10.0	50 K 1%
R 9	7.0	100K 1%
R 8	3.0	200K
R 7	1.0	100K
R 6	1.0	100K
R 5	6.0	49.9K 1%
R 4	3.0	200K
R 3	5.0	75K
R 2	2.0	15K
R 1	4.0	47K
Q3	17.5	019
Q2	17.0	200055
Q1	16.0	2N3565
CR-2	18.0	018
CR-1	18.0	018

CROSS REFERENCE CHART	
ITEM NO	PART NO.
19.0	410227 C
22.0	610238
23.0	610237
24.0	920008

4. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS
3. HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO. LOCATED AS SHOWN
2. SCHEMATIC REFERENCE: 430376
1. ALL RESISTORS 1/8 W, 5%, CARBON.

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
402004	5500	1	1
APPLICATION		QTY REQD	

MATERIAL
APPLIED FINISH
HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: .X ± .030, .XX ± .020, .XXX ± .010
ANGLES: ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

CONTRACT NO.

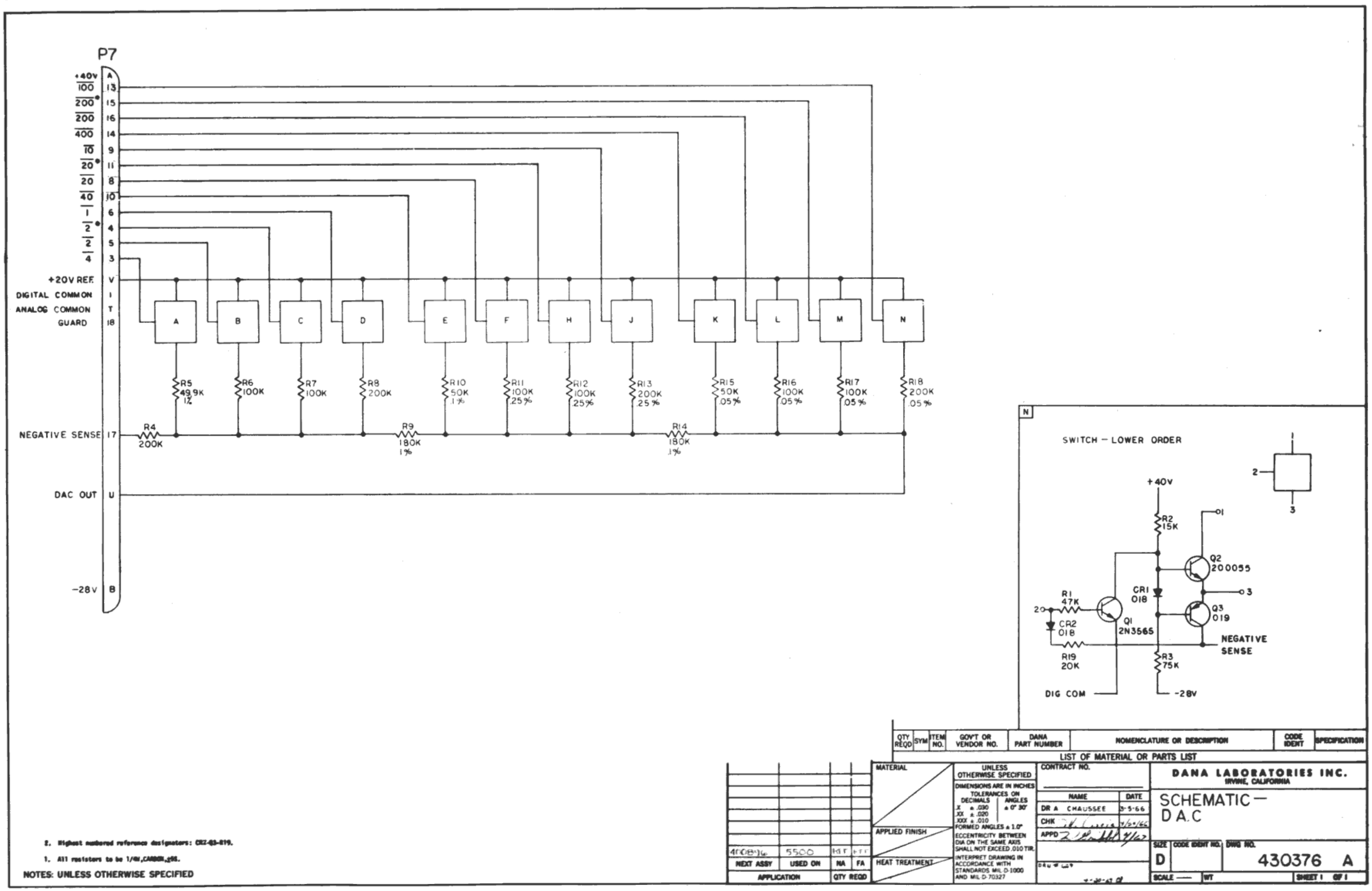
	NAME	DATE
DR	R WOOD	9/9/66
CHK	[illegible]	10/4/66
APPD	[illegible]	10/-/66
PROJ ENG	[illegible]	-/-/67

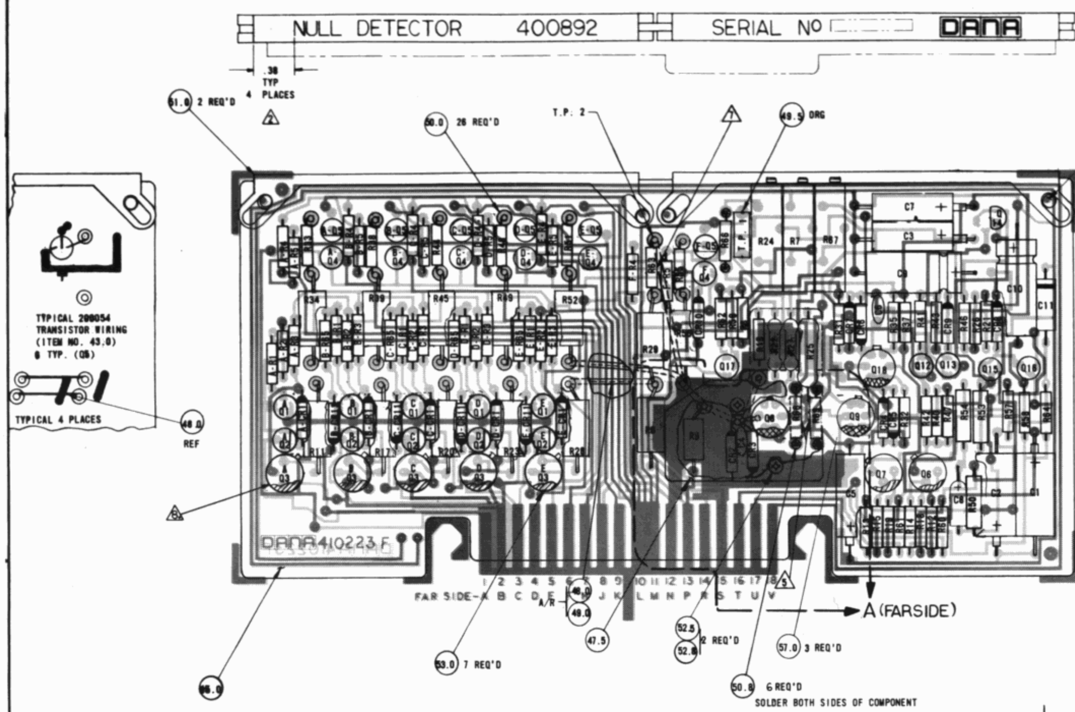
DRW # 629
1-29-67 4

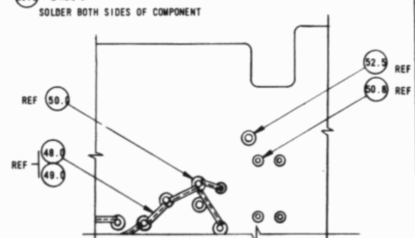
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASSY — DAC

SIZE D | CODE IDENT NO. — | DWG NO. 400896 B
SCALE 2:1 | WT — | SHEET 1 OF 1


P7
+40V
100
200
200
400
10
20
20
40
1
2
2
4
+20V REF.
DIGITAL COMMON
ANALOG COMMON
GUARD
NEGATIVE SENSE
DAC OUT
-28V
R4 200K
R5 49.9K 1%
R6 100K
R7 100K
R8 200K
R9 180K 1%
R10 50K 1%
R11 100K .25%
R12 100K .25%
R13 200K .25%
R14 180K 1%
R15 50K .05%
R16 100K .05%
R17 100K .05%
R18 200K .05%
SWITCH — LOWER ORDER
+40V
R1 47K
R2 15K
R3 75K
R19 20K
CR1 018
CR2 018
Q1 2N3565
Q2 200055
Q3 019
NEGATIVE SENSE
DIG COM
-28V
2. Highest numbered reference designators: CR2-Q3-R19.
1. All resistors to be 1/4W, CARBON, ±5%.
NOTES: UNLESS OTHERWISE SPECIFIED
LIST OF MATERIAL OR PARTS LIST
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC — D.A.C
DR A CHAUSSEE 3-5-66
D
430376 A
5500
NEXT ASSY
USED ON
APPLICATION
SHEET 1 OF 1





DETAIL A

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
45.0	410223 E
47.5	452113
48.0	500004
49.0	501376
49.5	800146
50.0	800243
50.8	800234
51.0	810236
52.0	810237
52.5	810262
52.8	815014
53.0	920006
57.0	920082

8. Q3(A:RHBU E), A 019 TYPE TRANSISTOR MAY BE SUBSTITUTED WITH FAIRCHILD 009
7. SOLDER BUS WIRE (ITEM 48.0) AS PERMANENT INSTALLATION. NORMALLY NO FSV RESISTOR IS USED.
6. TACK SOLDER ITEM 48.0 BUS WIRE IN PLACE OF FSV RESISTORS AT INITIAL ASSEMBLY. PROPER FSV RESISTORS WILL BE INSTALLED BY CHECKOUT GROUP.
5. FSV R68 OR R 69 SELECTED AS NECESSARY TO ZERO T C.
4. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS
3. SCHEMATIC REFERENCE : 430379
2. HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO, LOCATED AS SHOWN
1. ALL RESISTORS TO BE ¼W, 5%, CARBON.

NOTES: UNLESS OTHERWISE SPECIFIED

REF DES	B/M ITEM	DESCRIPTION
Q12	40.0	2N3646
Q9	41.0	016
Q8	39.1	015
Q7	37.0	009
Q6	39.0	014
Q5	43.0	200054
Q4	42.0	2N3565
Q3	40.5	019
Q2	43.0	200054
Q1	42.0	2N3565
CR11	44.0	018
CR10	44.5	1N961B ZENER
CR9	44.0	018
↕	↕	↕
CR4	44.0	018
CR3	43.5	S 368
CR2	43.5	S 368
CR1	44.0	018
C11	36.5	.0022UF/100V
C10	36.3	50UF/50V
C9	36.3	50UF/50V
C8	33.5	1 UF/35V
C7	35.0	25UF/25V
C6	33.3	150 pF DISC
C5	35.0	25UF/25V
C4	33.0	220 pF DISC
C3	35.0	25UF/25V
C2	36.0	50UF/25V
C1	36.0	50UF/25V

REF DES	B/M ITEM	DESCRIPTION
R27	26.3	442 k 1%
R26	5.0	12 k
R25	26.5	2 MEG 1%
R24	31.0	10 k POT
R23	28.0	99.995 k .01%
R22	26.0	365 k 1%
R21	20.0	6.2 k
R20	28.0	99.995 k .01%
R19	10.0	200 OHMS
R18	10.0	200 OHMS
R17	28.0	99.995 k .01%
R16	18.0	51 MEG
R15	1.0	1 k
↕	↕	↕
R12	1.0	1 k
R11	28.0	99.995 k .01%
R9	27.0	10 k .01%
R8	28.0	180 k .01%
R7	30.0	100 k POT
R6	22.0	82 k
R5	10.2	20 k
R4	17.0	47 k
R3	19.0	56 k
R2	5.0	12 k
R1	17.0	47 k
Q18	41.0	016
Q17	42.0	2N3565
Q16	42.0	2N3565
Q15	42.0	2N3565
Q14	38.0	012
Q13	40.0	2N3646

REF DES	B/M ITEM	DESCRIPTION
R61	0.5	100 OHMS
R60	0.5	100 OHMS
R59	16.1	3.9 k
R58	6.0	120 k
R57	13.1	30 k
R56	28.0	199.98 k .01%
R55	25.0	FSV
R54	24.0	4.7 k 1/2 W
R53	23.0	5.1 k 1/2 W
R52	28.0	99.980 K .01%
R51	25.0	FSV
R50	24.0	4.7 k 1/2 W
R49	28.0	99.980 K .01%
R48	25.0	FSV
R47	9.0	18 k
R46	4.9	1.2 k
R45	28.0	99.980 K .01%
R44	25.0	FSV
R43	17.6	5.1 k
R42	12.0	27 k
R41	17.6	5.1 k
R40	1.0	1 k
R39	28.0	99.980 k .01%
R38	25.0	FSV
R37	14.0	330 OHMS
R35	2.0	100 k
R34	28.0	199.980 k .01%
R33	25.0	FSV
R32	4.0	110 k
R31	2.0	100 k
R29	28.0	180 k .01%
R28	28.0	199.995 k .01%

REF DES	B/M ITEM	DESCRIPTION
R69	25.0	FSV (5)
R68	25.0	FSV (5)
R67	32.0	100 OHMS POT
R66	25.0	FSV
R-R65	21.0	6.8 K
R65	7.0	13 k
R64	17.0	47 k
R63	25.0	FSV (7)
R62	10.0	200 OHMS

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
402004	5500	1	1
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS .X .030 .XX .020 .XXX .010 | ANGLES 0° 30' | FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

DRAWN J. MONROY SEPT.
CHECK 10-10-66
COG ENGR 10/14/66
PROJ ENGR

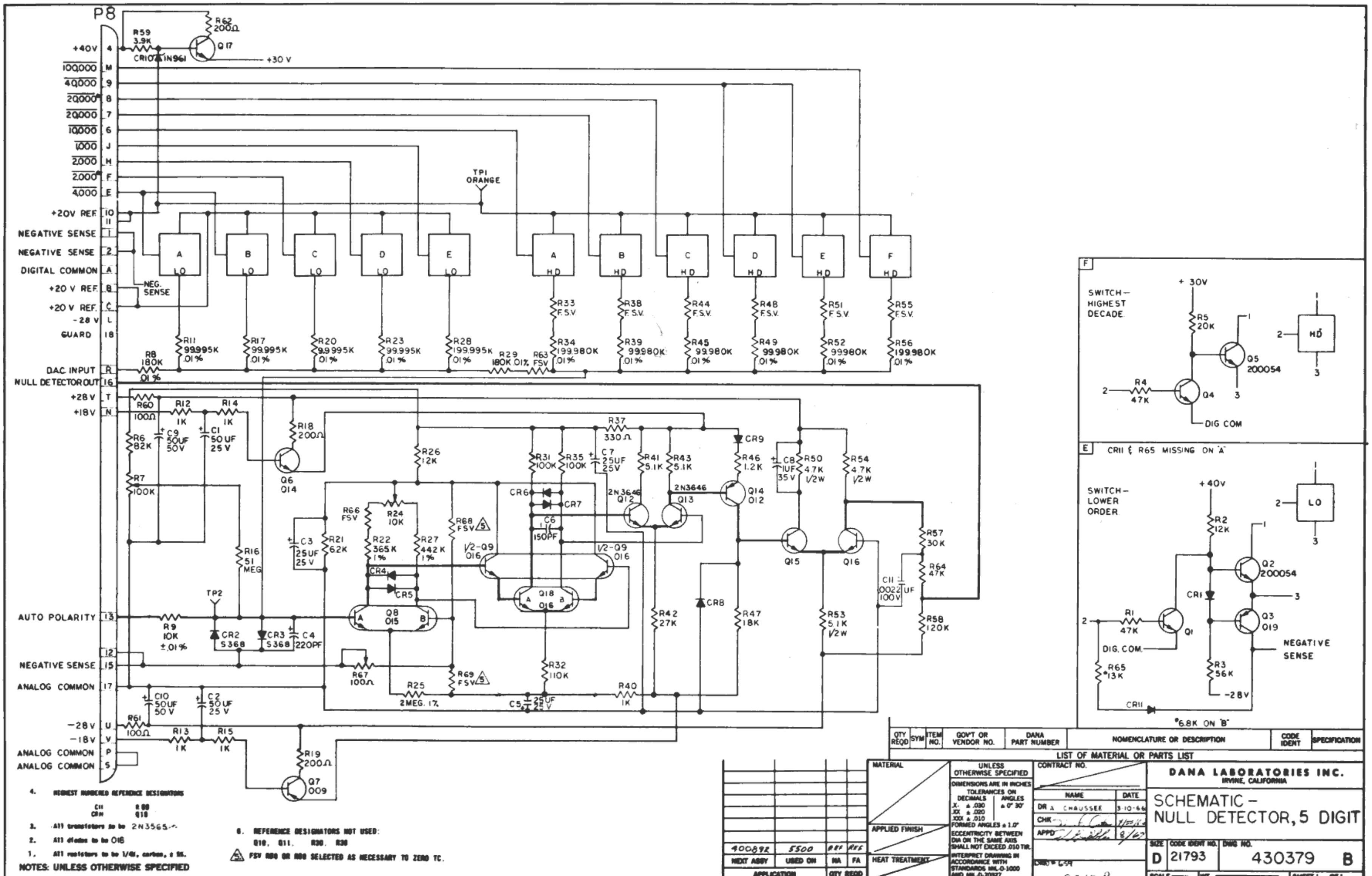
ORN # 659 9-2-67

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

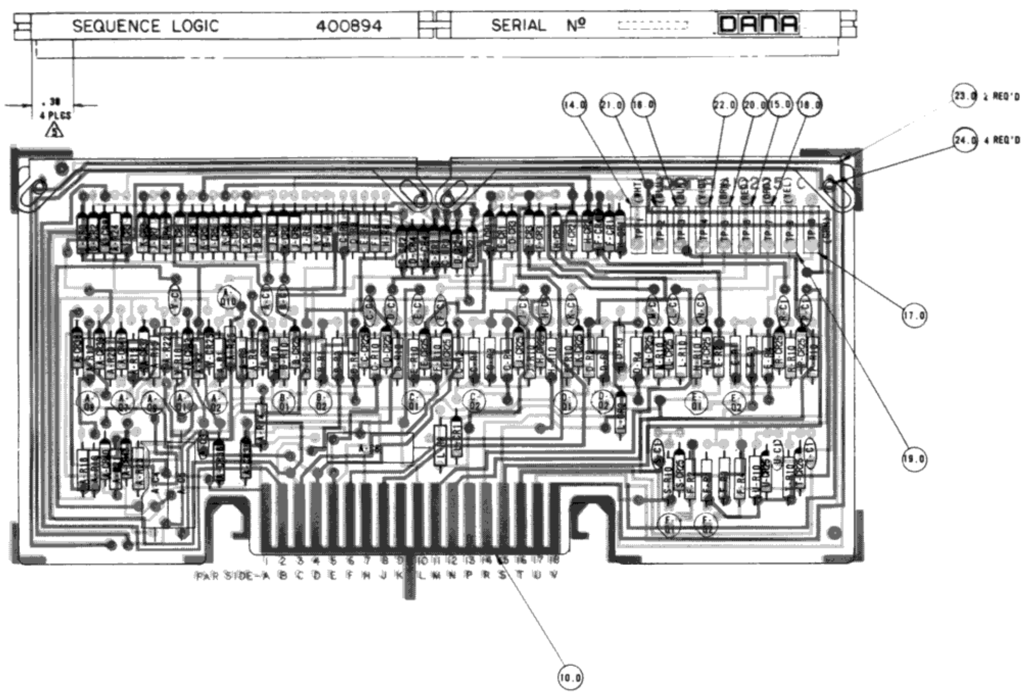
P.C. BD. ASSY. - NULL DETECTOR, 5 DIGIT

SIZE D | CODE IDENT NO. 21793 | DWG NO. 400892 | REV D

SCALE 2=1 | WT | SHEET 1 OF 1



SCHEMATIC - NULL DETECTOR, 5 DIGIT
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
D 21793 430379 B
SWITCH - HIGHEST DECADE
SWITCH - LOWER ORDER
CR11 & R65 MISSING ON "A"
*6.8K ON "B"
NOTES: UNLESS OTHERWISE SPECIFIED
1. All resistors to be 1/4W, carbon, ± 5%.
2. All diodes to be 016
3. All transistors to be 2N3565
4. Highest numbered reference designators
5. FSV R68 or R69 selected as necessary to zero TC.
6. Reference designators not used: Q10, Q11, R30, R36
LIST OF MATERIAL OR PARTS LIST
P8
+40V
NEGATIVE SENSE
DIGITAL COMMON
+20 V REF.
GUARD
DAC INPUT
NULL DETECTOR OUT
AUTO POLARITY
ANALOG COMMON
TP1 ORANGE



R8	1.0	12 K
B-R8	4.7	5.1 k
L-R8	4.7	5.1 k
R4	2.0	15 K
R3	3.0	2.2 K
R2	2.0	15 K
R1	3.0	2.2 K
CR44	9.0	018
↑	↑	↑
THRU		
↓		
CR37		
—		
CR25		
—		
CR12		
↑		
THRU		
↓	↓	
CR1	9.0	018
C6	7.7	.068UF 100V
V-C1	5.5	68PF DISC
C5	7.7	.068 UF 100V
C4	7.7	.068 UF 100V
C3	7.3	47 PF DISC
C1	6.0	33 PF DISC
REF DES	B/M ITEM	DESCRIPTION

Q10	8.0	2N3646
↕	↕	↑
THRU		
Q7	8.0	
Q2	8.0	↓
Q1	8.0	2N3646
R14	2.0	15k
R25	5.0	8.2 K
R24	4.5	33 K
R23	4.0	27 K
R22	2.0	15 K
R21	2.0	15 K
R20	2.0	15 K
R19	5.0	8.2 K
R18	.5	100 K
R17	2.0	15 K
R16	5.0	8.2 K
R15	4.0	27 K
R10	4.0	27 K
REF DES	B/M ITEM	DESCRIPTION

CROSS REFERENCE CHART	
ITEM NO.	PART NO.
10.0	410225C
14.0	600142
15.0	600143
16.0	600144
17.0	600145
18.0	600146
19.0	600147
20.0	600148
21.0	600149
22.0	600150
23.0	610236
24.0	610237

5. HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO, LOCATED AS SHOWN
4. SCHEMATIC REFERENCE: #430393
3. ASSEMBLY PROCEDURES & PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS
2. ALL DIODES TO BE 018
1. ALL RESISTORS TO BE 1/4 W ± 5%. CARBON

NOTE: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
402004	5500	1	1
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X .030 .XX .020 .XXX .010 | ANGLES 0° 30' | FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

DRAWN R. WEED 18 OCT 66
CHECK R PECHAL 10/26/66
COG. ENGR
PROJ ENGR

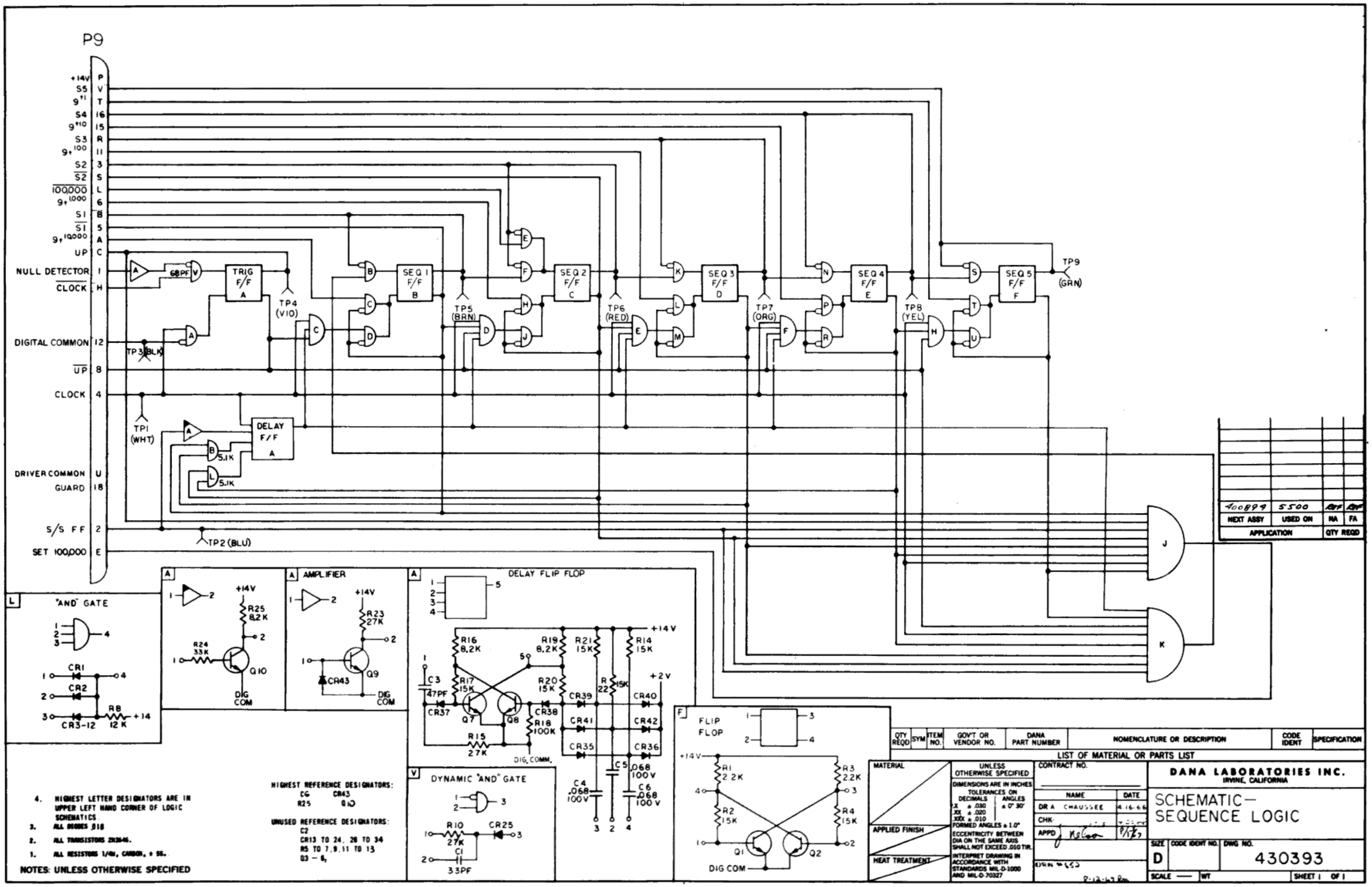
DAN # 662
8-18-67

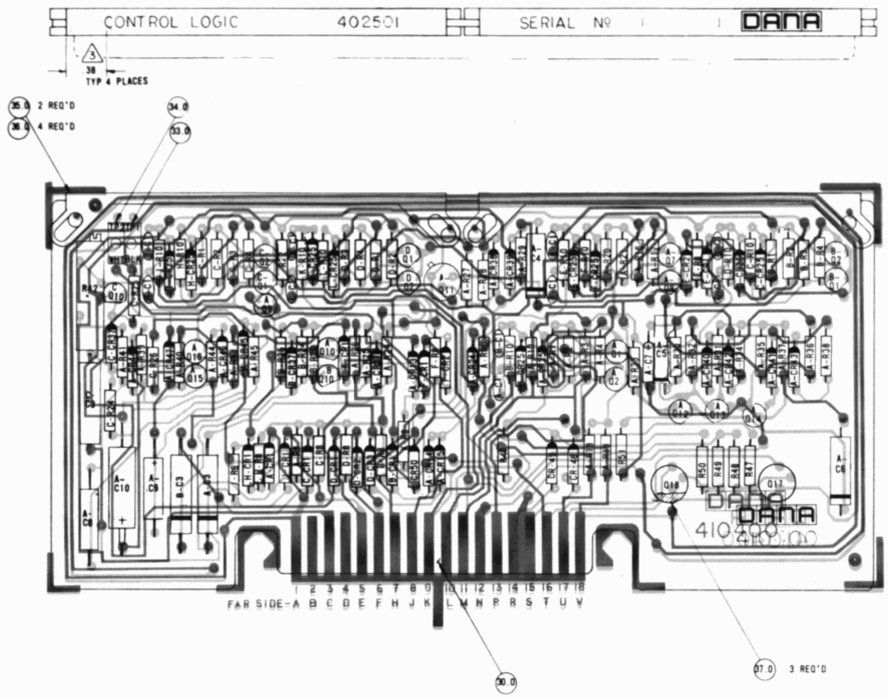
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P C BOARD - SEQUENCE LOGIC

SIZE D | CODE IDENT NO. — | DWG NO. 400894 | REV A

SCALE 2/1 | WT — | SHEET 1 OF 1


P9
+14V P
S5 V
9+11 T
S4 16
9+10 15
S3 R
9+100 11
S2 3
S2 S
100,000 L
9+1000 6
S1 B
S1 5
9+10,000 A
UP C
NULL DETECTOR 1
CLOCK H
DIGITAL COMMON 12
UP 8
CLOCK 4
DRIVER COMMON U
GUARD 18
S/S FF 2
SET 100,000 E
TRIG F/F A
DELAY F/F A
SEQ 1 F/F B
SEQ 2 F/F C
SEQ 3 F/F D
SEQ 4 F/F E
SEQ 5 F/F F
TP1 (WHT)
TP2 (BLU)
TP3 (BLK)
TP4 (VIO)
TP5 (BRN)
TP6 (RED)
TP7 (ORG)
TP8 (YEL)
TP9 (GRN)
68PF
5.1K
"AND" GATE
CR1
CR2
CR3-12
R8 12K
+14
AMPLIFIER
+14V
R25 8.2K
R24 33K
Q10
DIG COM
R23 27K
CR43
Q9
DELAY FLIP FLOP
R16 8.2K
R19 8.2K
R21 15K
R14 15K
+14V
+2V
C3 47PF
R17 15K
R20 15K
R 22
15K
CR37
Q7
Q8
CR38
R18 100K
CR39
CR40
CR41
CR42
CR35
CR36
R15 27K
DIG. COMM.
C4 .068 100V
C5 .068 100V
C6 .068 100V
DYNAMIC "AND" GATE
R10 27K
CR25
C1 33PF
FLIP FLOP
R1 2.2K
R2 15K
R3 2.2K
R4 15K
Q1
Q2
DIG COM
4. HIGHEST LETTER DESIGNATORS ARE IN UPPER LEFT HAND CORNER OF LOGIC SCHEMATICS
3. ALL DIODES 918
2. ALL TRANSISTORS 2N3646.
1. ALL RESISTORS 1/4W, CARBON, ± 5%.
NOTES: UNLESS OTHERWISE SPECIFIED
HIGHEST REFERENCE DESIGNATORS:
C6 CR43
R25 Q10
UNUSED REFERENCE DESIGNATORS:
C2
CR13 TO 24, 26 TO 34
R5 TO 7, 9, 11 TO 13
Q3 - 6,
400899 5500
NEXT ASSY USED ON NA FA
APPLICATION QTY REQD
QTY REQD SYM ITEM NO. GOV'T OR VENDOR NO. DANA PART NUMBER NOMENCLATURE OR DESCRIPTION CODE IDENT SPECIFICATION
LIST OF MATERIAL OR PARTS LIST
MATERIAL
APPLIED FINISH
HEAT TREATMENT
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS ANGLES
.X ± .030 ± 0° 30'
.XX ± .020
.XXX ± .010
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .050 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327
CONTRACT NO.
NAME DATE
DR A CHAUSSEE 4-16-66
CHK
APPD
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC—
SEQUENCE LOGIC
SIZE D
CODE IDENT NO.
DWG NO. 430393
SCALE —
WT
SHEET 1 OF 1



CROSS REFERENCE CHART	
ITEM NO.	PART NO.
30.0	410400
33.0	600142
34.0	600144
35.0	610236
36.0	610237
37.0	920006

REF DES	B/M ITEM	DESCRIPTION	REF DES	B/M ITEM	DESCRIPTION	REF DES	B/M ITEM	DESCRIPTION
			R 25	2.0	100K			
			R 24	6.0	15K			
Q2	28.0	2N3646						
Q1	28.0	2N3646	R 22	7.0	200 OHMS			
			R 21	6.0	15K			
			R 20	3.0	1.2K			
CR50	29.0	018	R 19	16.0	8.2K			
			R 18	16.0	8.2K			
			R 17	6.0	15K	R51	14.0	27k
CR37			R 16	3.0	1.2K	R 50	1.0	10K
CR25			R 10	14.0	27K	R 47	1.0	10K
CR24			R 9	9.0	200K	R 46	16.0	8.2K
			H-R8	4.0	4.3k	R 45	13.0	24 K
CR14			R8	4.0	12k	R 44	2.0	100K
CR13						R 43	11.0	2.2K
			R 4	6.0	15K	R 42	17.0	20K POT
			R 3	11.0	2.2K	R 41	5.0	13K
CR 3			R 2	6.0	15K	R 40	11.0	2.2K
CR 2			R 1	11.0	2 2K	R 39	2.0	100K
CR 1	29.0	018				R 38	15.5	7.5 K
A-C1	19.5	47PF				R 37	2.0	100K
B-C1	19.5	47PF	Q 18	28.5	200079	R 36	3.0	1.2K
C 10	22.0	25UF 25V	Q 17	28.5	200079	R 35	8.0	20K
C 9	17.5	6.8UF 35V	Q 16	28.0	2N3646	R 34	8.0	20K
C 8	17.5	6.8UF 35V				R 33	10.0	220 OHMS
C 7	20.0	1 UF 35V				R 32	3.0	1.2K
C 6	22.5	.015UF 100V	Q 12	28.0	2N3646	R 31	2.0	100K
C 5	25.0	.0015UF 100V	Q 11	26.0	009	R 30	8.0	15K
C 4	25.0	.0015UF 100V	Q 10	28.0	2N3646	R 29	12.0	2.4K
C 3	23.0	.047 UF 100V	Q 9			R 28	6.0	15K
K-C1	19.0	100 PF	Q 8			R 27	15.0	6.2K
C 1	18.0	33 PF	Q 7	28.0	2N3646	R 26	16.0	8.2K

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS TO BE ¼W, ±5%, CARBON.
2. SCHEMATIC REFERENCE: 430005
3. HEAT STAMP .10 HIGH BLACK CHARACTERS AND .15 HIGH LOGO, LOCATED AS SHOWN
4. ASSEMBLY PRODECURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS

QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

402004	5500	1	1
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS: .X ± .030, .XX ± .020, .XXX ± .010
ANGLES: ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

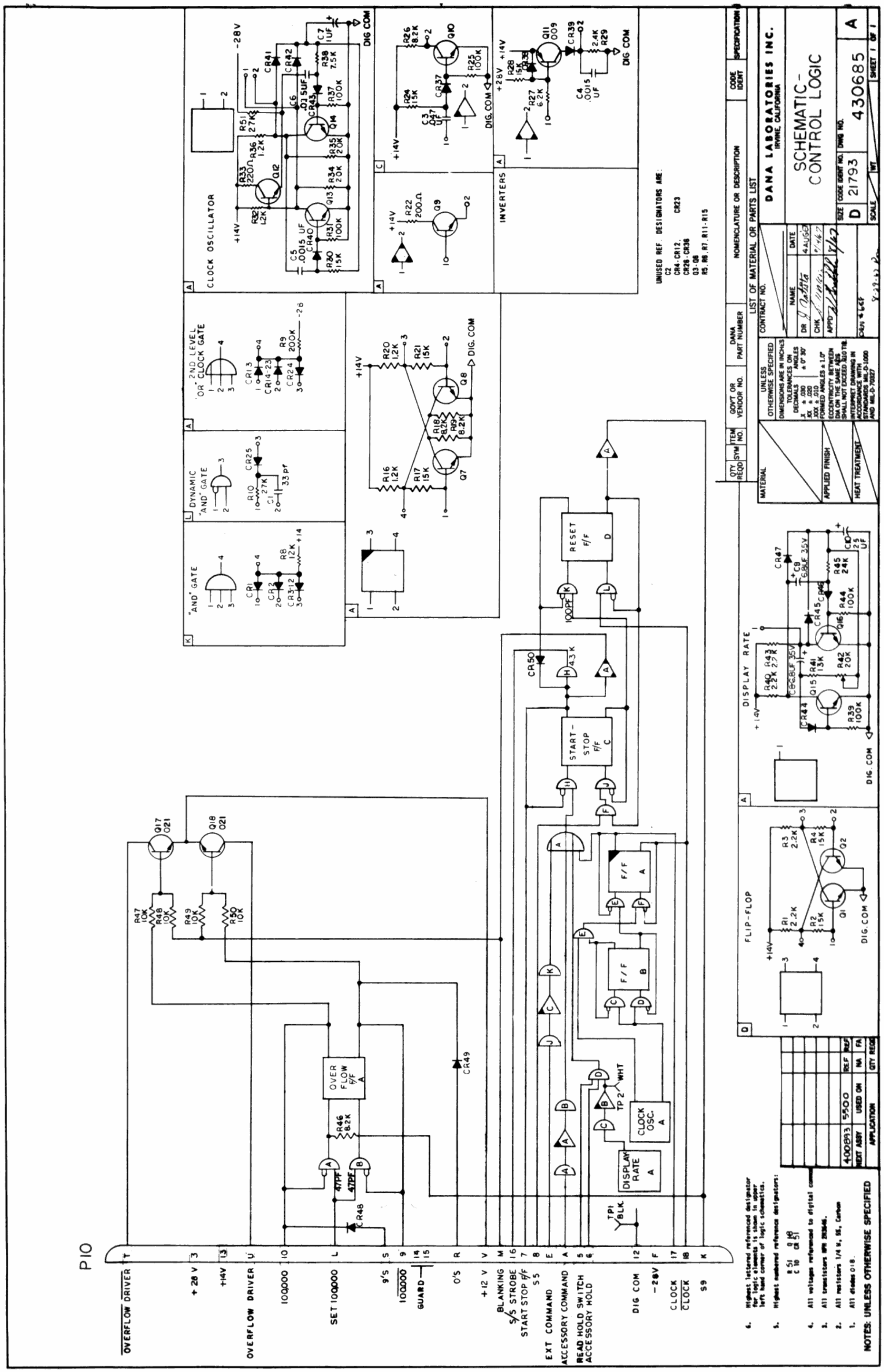
CONTRACT NO.

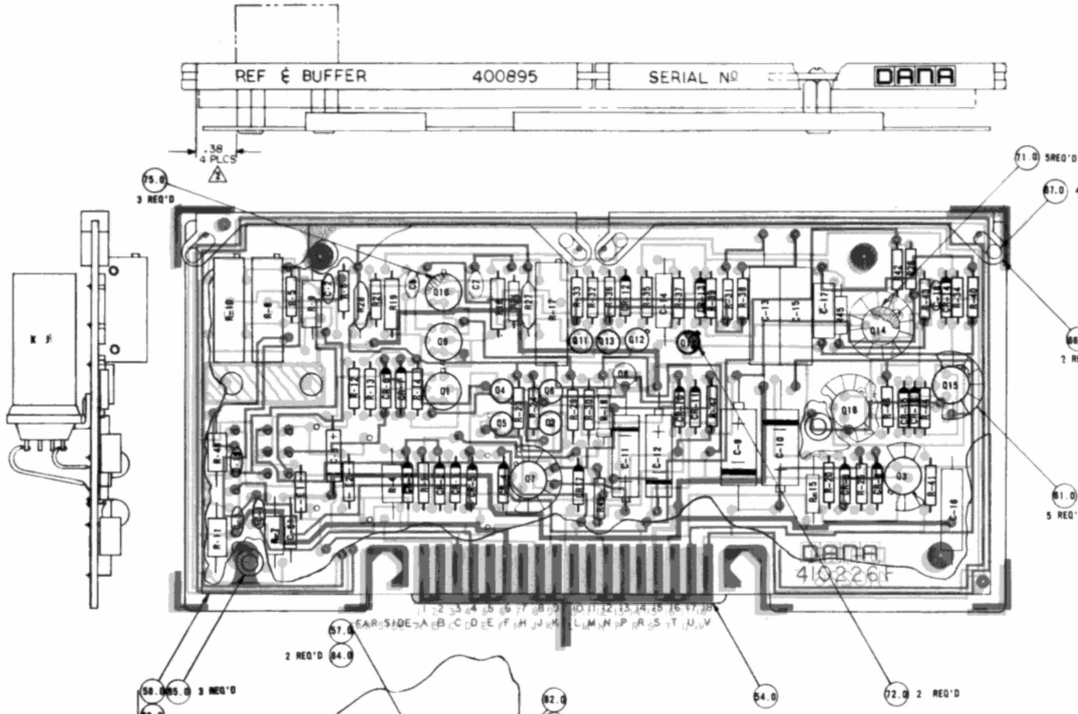
	NAME	DATE
DR		AUG 67
CHK		
APPD		

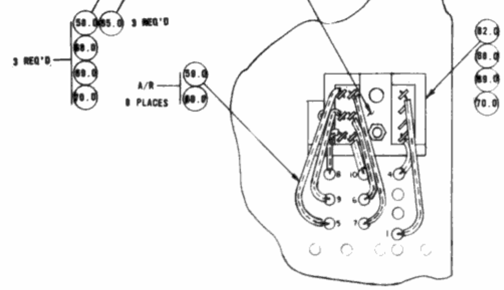
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C.B. ASSY - CONTROL LOGIC

SIZE	CODE IDENT NO.	DWG NO.	
D	21793	402501	B
SCALE 2/1	WT		SHEET 1 OF 1


P10
OVERFLOW DRIVER
+28 V
+14V
OVERFLOW DRIVER
100,000
SET 100,000
9's
100,000
GUARD
0's
+12 V
BLANKING
S/S STROBE
START STOP F/F
S5
EXT COMMAND
ACCESSORY COMMAND
READ HOLD SWITCH
ACCESSORY HOLD
DIG COM
-28V
CLOCK
CLOCK
S9
OVER FLOW F/F A
DISPLAY RATE A
CLOCK OSC. A
START-STOP F/F C
RESET F/F D
F/F A
F/F B
CLOCK OSCILLATOR
INVERTERS
"AND" GATE
DYNAMIC "AND" GATE
2ND LEVEL 'OR' CLOCK GATE
FLIP-FLOP
DISPLAY RATE
DIG. COM
UNUSED REF. DESIGNATORS ARE:
C2
CR4-CR12, CR23
CR26-CR36
Q3-Q6
R5, R6, R7, R11-R15
NOTES: UNLESS OTHERWISE SPECIFIED
1. All diodes 018.
2. All resistors 1/4 W, 5%, Carbon
3. All transistors NPN 2N3646.
4. All voltages referenced to digital common
5. Highest numbered reference designators: R51 Q18 C10 CR51
6. Highest lettered reference designator for logic elements is shown in upper left hand corner of logic schematics.
400893 5500
NEXT ASSY USED ON
APPLICATION
LIST OF MATERIAL OR PARTS LIST
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
SCHEMATIC-
CONTROL LOGIC
D 21793 430685 A
SHEET 1 OF 1





CROSS REFERENCE CHART	
ITEM NO.	PART NO.
54.0	410226 F
57.0	450854
58.0	452080
59.0	500004
60.0	501376
61.0	600016
62.0	600221
64.0	610019
65.0	610218
66.0	610236
67.0	610237
68.0	615042
69.0	617004
70.0	617077
71.0	920006
72.0	920007
75.0	920082

REF DES	B/M ITEM	DESCRIPTION
CR17	47.7	SD4
CR16	48.0	018
CR15	48.0	018
CR14	48.0	↕
CR13	48.0	↕
CR12	48.0	018
CR11	49.5	1N961 B
CR10	51.0	1N958 B
CR8	48.0	018
↕	↕	↕
THRU	↕	↕
↕	↕	↕
CR4	48.0	018
CR3	53.0	FSV ZENER
CR2	49.0	007
CR1	50.0	1N751
C19	33.0	150PF DISC
C18	31.0	100 PF DISC
C17	40.0	.01 UF 100V
C16	41.0	.047 UF 100V
C15	34.0	6 UF 25V
C14	39.0	.0033 UF 100V
C13	34.0	6 UF 25V
C12	37.0	50 UF 15V
C11	37.0	50 UF 15V
C10	36.0	25 UF 50 V
C9	36.0	25 UF 50 V
C8	32.0	470 PF
C7	32.0	470 PF
C6	33.5	6.8 UF 35V
C5	38.0	1 UF 35V
C3	33.0	150 PF DISC
C2	31.0	100 PF DISC
C1	31.0	100 PF DISC

REF DES	B/M ITEM	DESCRIPTION
R31	1.0	100 OHMS
R30	26.0	750 OHMS 1%
R29	25.0	12 K 1%
R28	23.0	4.02 K 1%
R27	23.0	4.02 K 1%
R26	1.0	100 OHMS
R25	19.5	8.2 K
R24	12.0	3.3 MEG
R23	15.0	5.6 MEG
R22	10.0	2.4 K
R21	10.0	2.4 K
R20	16.0	68 OHMS
R19	24.0	324 K 1%
R18	22.0	11 K 1%
R17	29.0	50 K POT
R16	24.0	324 K 1%
R15	21.0	680 OHMS 1/2 W
R14	2.0	100 MEG
R13	2.0	100 MEG
R12	17.0	680 OHMS
R11	53.0	FSV .01%
R10	27.5	20K POT
R9	28.5	10K .01%
R8	28.0	5 K POT
R7	28.5	10K .01%
R6	3.5	12 MEG OHMS.
R5	21.5	3.8 OHMS
R4	53.0	FSV 1%
R1	14.0	5.1 K
K1	52.0	RELAY 2 POLE
E2	63.0	JUMPER, INSL.
E1	63.0	JUMPER, INSL.

REF DES	B/M ITEM	DESCRIPTION
Q17	43.0	012
Q16	42.0	009
Q15	42.0	009
Q14	42.0	009
Q13	47.0	2N3565
Q12	43.0	012
Q11	47.0	2N3565
Q10	46.0	016
Q9	46.0	016
Q8	47.0	2N3565
Q7	42.0	009
Q6	47.0	2N3565
Q5	47.5	200044
Q4	47.5	200044
Q3	44.0	014
Q2	47.0	2N3565
Q1	45.0	015
R49	6.2	15K
R48	27.0	13.8K .01%
R47	3.0	1.2 K
R46	5.0	15 OHMS
R45	20.0	3.9 K 1/2 W
R44	5.0	15 OHMS
R43	8.5	22 OHMS
R42	5.0	15 OHMS
R41	4.0	13 K
R40	1.1	1 K
R39	9.0	220 OHMS
R38	1.0	100 OHMS
R37	6.0	150 OHMS
R36	1.0	100 OHMS
R35	8.0	200 OHMS
R34	19.0	7.5 K
R33	1.0	100 OHMS
R32	7.0	160 OHMS

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

5. ASSEMBLY PROCEDURE & PROCESSES TO COMPLY WITH DANA WORKMANSHIP STANDARDS
4. SCHEMATIC REFERENCE NO. 430305
3. DIODES ARE 018
2. HEAT STAMP .10 HIGH BLACK CHARACTERS & .10 HIGH LOGO, LOCATED AS SHOWN
1 RESISTORS TO BE 1/4 W, ± 5%, CARBON

NOTE: UNLESS OTHERWISE SPECIFIED

402004	5503	1	1
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS: .X .030, .XX .020, .XXX .010 | ANGLES 0° 30' | FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

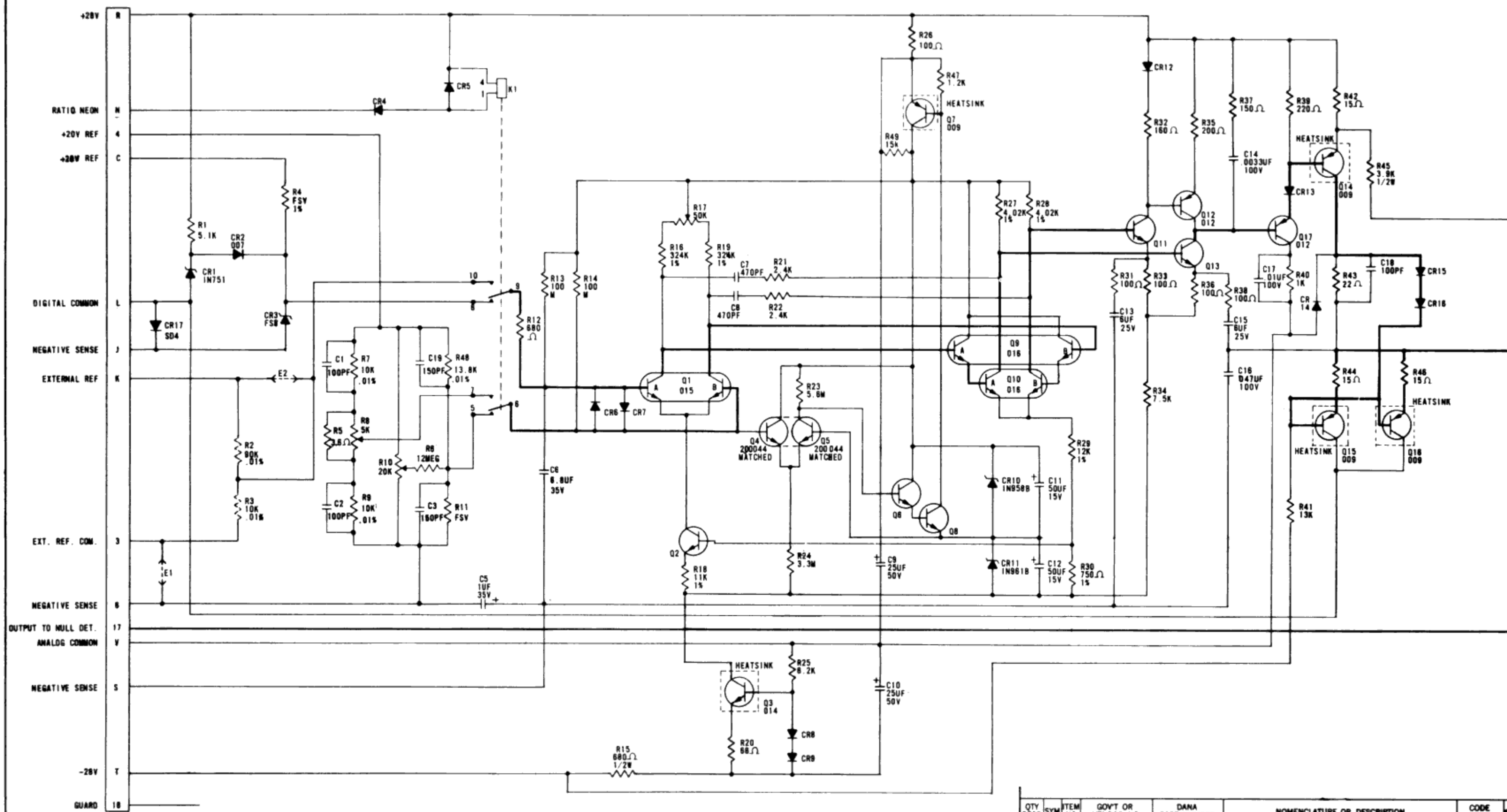
DRAWN R WOOD 13 OCT 66
CHECK 10-18-66
COG. ENGR M. C...
PROJ ENGR J. Nelson

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

P.C. BOARD ASS'Y — REFERENCE & BUFFER

SIZE D | CODE IDENT NO. 21793 | DWG NO. 400895 | REV C

SCALE 2/1 | WT | SHEET 1 OF 1



QTY REQD	SYM	ITEM NO.	GOV'T OR VENDOR NO.	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION

LIST OF MATERIAL OR PARTS LIST

4. RELAY SHOWN IN DE-ENERGIZED POSITION
3. TRANSISTORS TO BE 2N3565.
2. DIODES TO BE TYPE 018.
1. RESISTORS TO BE ¼ W, ±5%, CARBON.

NOTES: UNLESS OTHERWISE SPECIFIED

7. JUMPERS E1 AND E2 TO BE INSTALLED WITH STANDARD 10V EXT. REF.
6. R2 AND R3 ARE OPTIONAL WITH 100V EXT. REF.
5. HIGHEST NUMBERED REFERENCE DESIGNATORS:
C 19 Q 16 K 1
CR 17 R 48

400895	5500	REF	REF
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

MATERIAL

APPLIED FINISH

HEAT TREATMENT

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
DECIMALS .X ± .030 .XX ± .020 .XXX ± .010
ANGLES ± 0° 30'
FORMED ANGLES ± 1.0°
ECCENTRICITY BETWEEN DIA ON THE SAME AXIS SHALL NOT EXCEED .010 TIR.
INTERPRET DRAWING IN ACCORDANCE WITH STANDARDS MIL-D-1000 AND MIL-D-70327

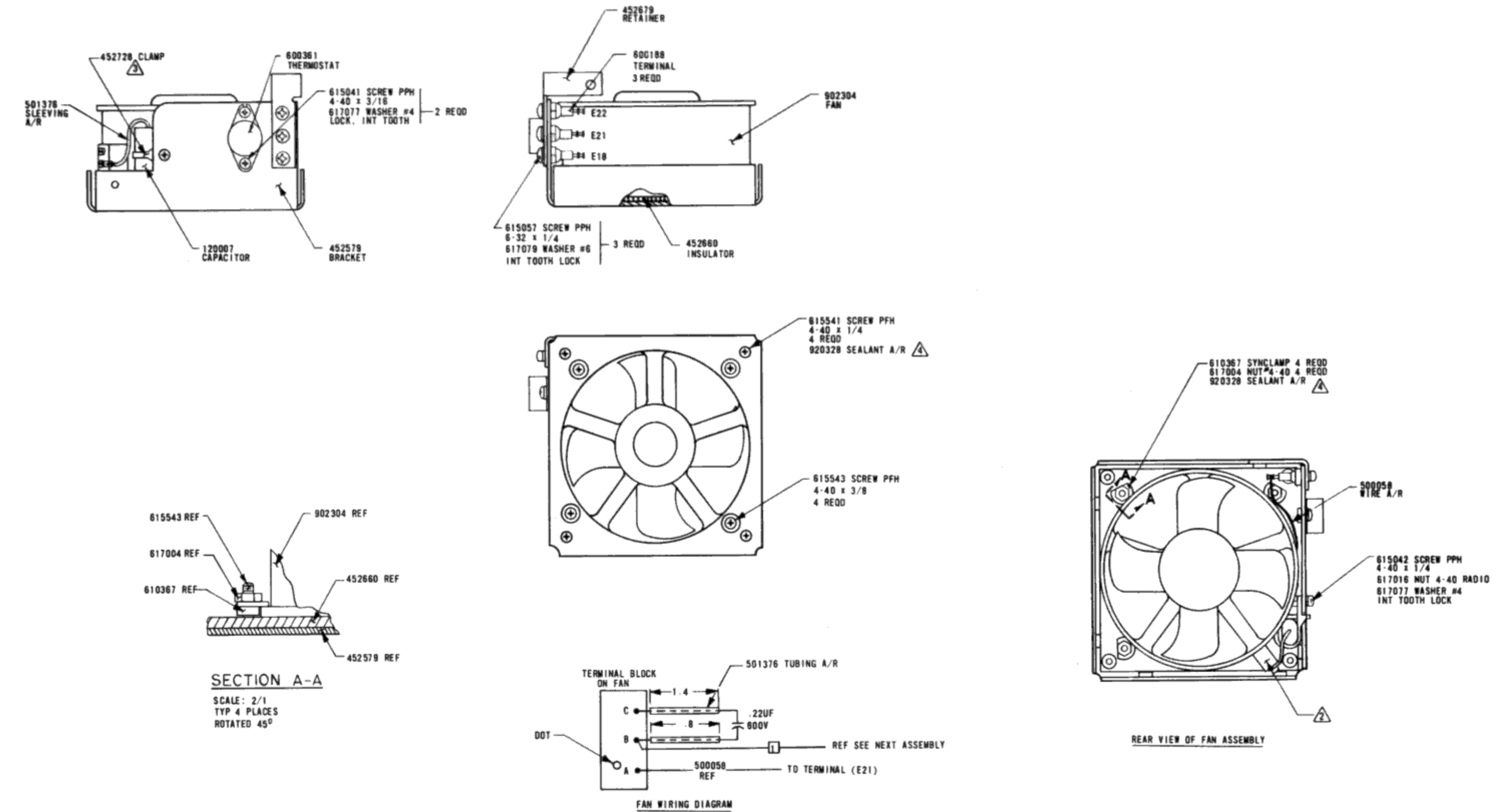
CONTRACT NO.

	NAME	DATE
DR		
CHK		
APPD		

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC – REFERENCE AND BUFFER AMPL.

SIZE	CODE IDENT NO.	DWG NO.	
D		430395	B
SCALE	WT		SHEET 1 OF 1



NOTES: UNLESS OTHERWISE SPECIFIED

1. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS
2. POSITION OF TERMINAL BLOCK TO BE IN SAME CORNER AS OFFSET SYNCLAMP. TERMINAL BLOCK TERMINALS NOT TO TOUCH ANY METAL SURFACE (.030 MIN)
3. EXCESS MATERIAL ON CLAMP TO BE TRIMMED AFTER INSTALLATION
4. APPLY LOCTITE PER APPLICATION SPECIFICATION 900075

NEXT ASSY	USED ON	NA	FA
402691	5524-S2056	1	1
402691	5524-STD	1	1
402541	5524	1	1

APPLICATION — QTY REQD

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS .X .030 .XX .020 .XXX .010 — ANGLES 0° 30' — FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

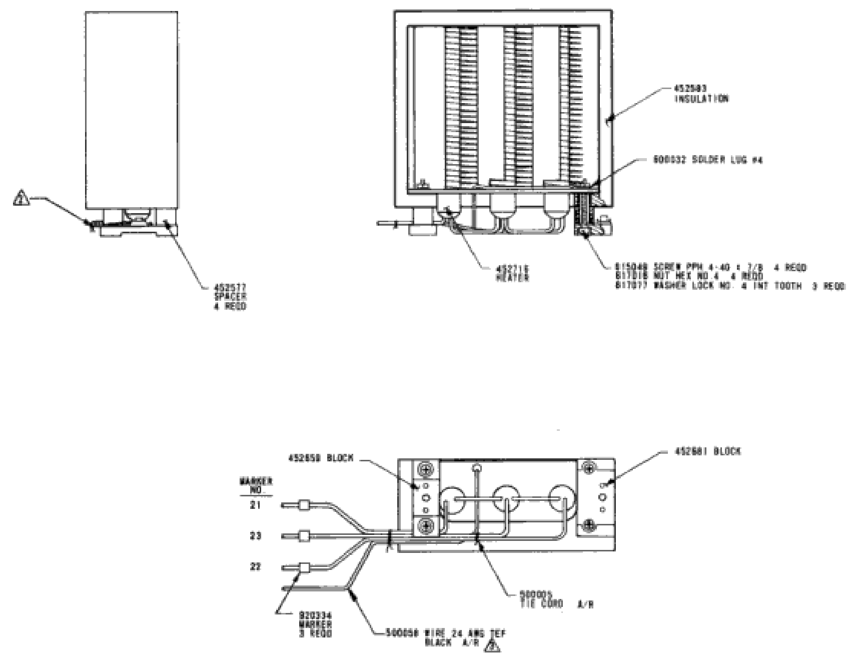
DRAWN	J. Harvey	1 NOV 1967
CHECK	J. Monroy	22 DEC 1967
DESIGN	J. Monroy	22 DEC 1967
PROJ ENGR		2-7-68

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ASSEMBLY - FAN

SIZE D — CODE IDENT NO. 21793 — DWG NO. 402548 — REV

SCALE 1/1 — WT — SHEET 1 OF 1



NOTES: UNLESS OTHERWISE SPECIFIED

1. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS

2. WIRES TO BE ROUTED AND TIED TO SPACER WITH TIE CORD EXACTLY AS SHOWN.

3. WIRE TO BE 12.0 ± .5 LONG FROM SOLDER LUG TO END.

NEXT ASSY	USED ON	NA	FA
402691	5524-S2056	1	1
402691	5524-STD	1	1
402541	5524	1	1

APPLICATION — QTY REQD

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X .XX .XXX; ANGLES 0° 30'; FORMED ANGLES

MATERIAL

FINISH

CONTRACT NO.

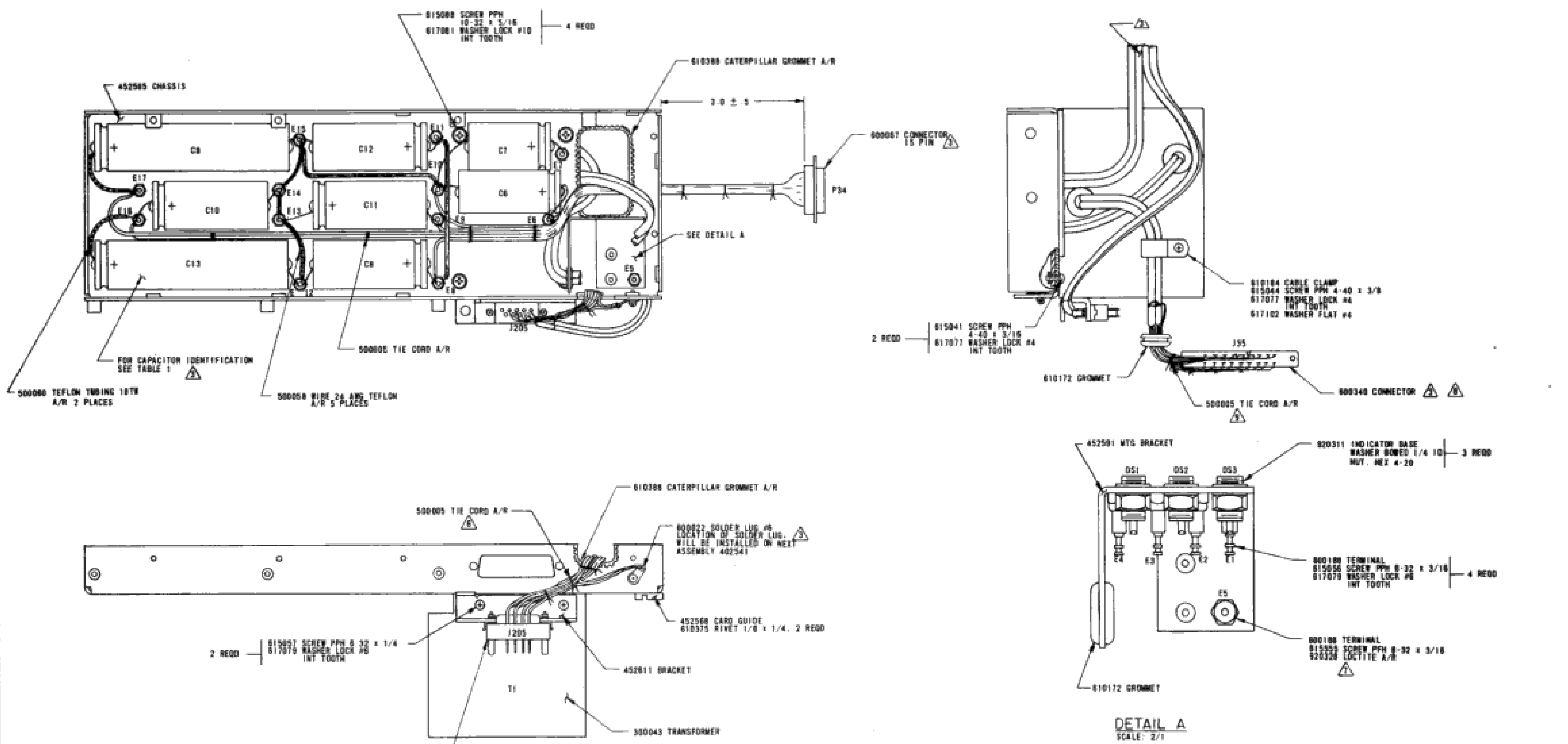
DRAWN Al Godsey; CHECK J. Monroy; DESIGN J. Monroy; PROJ ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ASSEMBLY-HEATER

SIZE D | CODE IDENT NO. 21793 | DWG NO. 402601 | REV

SCALE 1/1 | WT | SHEET 1 OF 1



8. WIRES TO BE TIED AND ROUTED BETWEEN CONNECTOR PINS
7. SEE NEXT ASSEMBLY FOR CONNECTOR POSITIONING TO DETERMINE CORRECT WIRE LENGTHS
6. APPLY LOCKTITE PER APPLICATION SPECIFICATION 900075
5. WIRES TO BE TIED FLAT
4. WIRING DIAGRAM FOR 115V POWER INPUT. WIRES INDICATED CHANGE PER SCHEMATIC 430758, FOR 230V APPLICATION
3. CABLE LENGTH TO BE FROM SOLDER POINT TO END
2. SEE WIRING DIAGRAM SHEET 2 OF 2
2. SCHEMATIC REF 430680, 430701, AND 430758
1. ASSEMBLY PROCESSES AND PROCEDURES TO CONFORM TO DANA WORKMANSHIP STANDARDS

NOTES: UNLESS OTHERWISE SPECIFIED

TABLE I

PART NO.	DESCRIPTION	REF DES
110074	50 MFD. 350V	C7
110073	500 MFD. 50V	C6
110075	2000MFD. 35V	C8,10-12
110076	3000 MFD. 35V	C9 & 13

NEXT ASSY	USED ON	NA	FA
402691	5524-STD	1	1
402691	5524-S2056	1	1

APPLICATION — QTY REQD

QTY REQD | DANA PART NUMBER | NOMENCLATURE OR DESCRIPTION | CODE IDENT | SPECIFICATION OR VENDOR P/N | ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X .030, .XX .020, .XXX .010; ANGLES 0° 30'; FORMED ANGLES 3.0

MATERIAL

FINISH

CONTRACT NO.

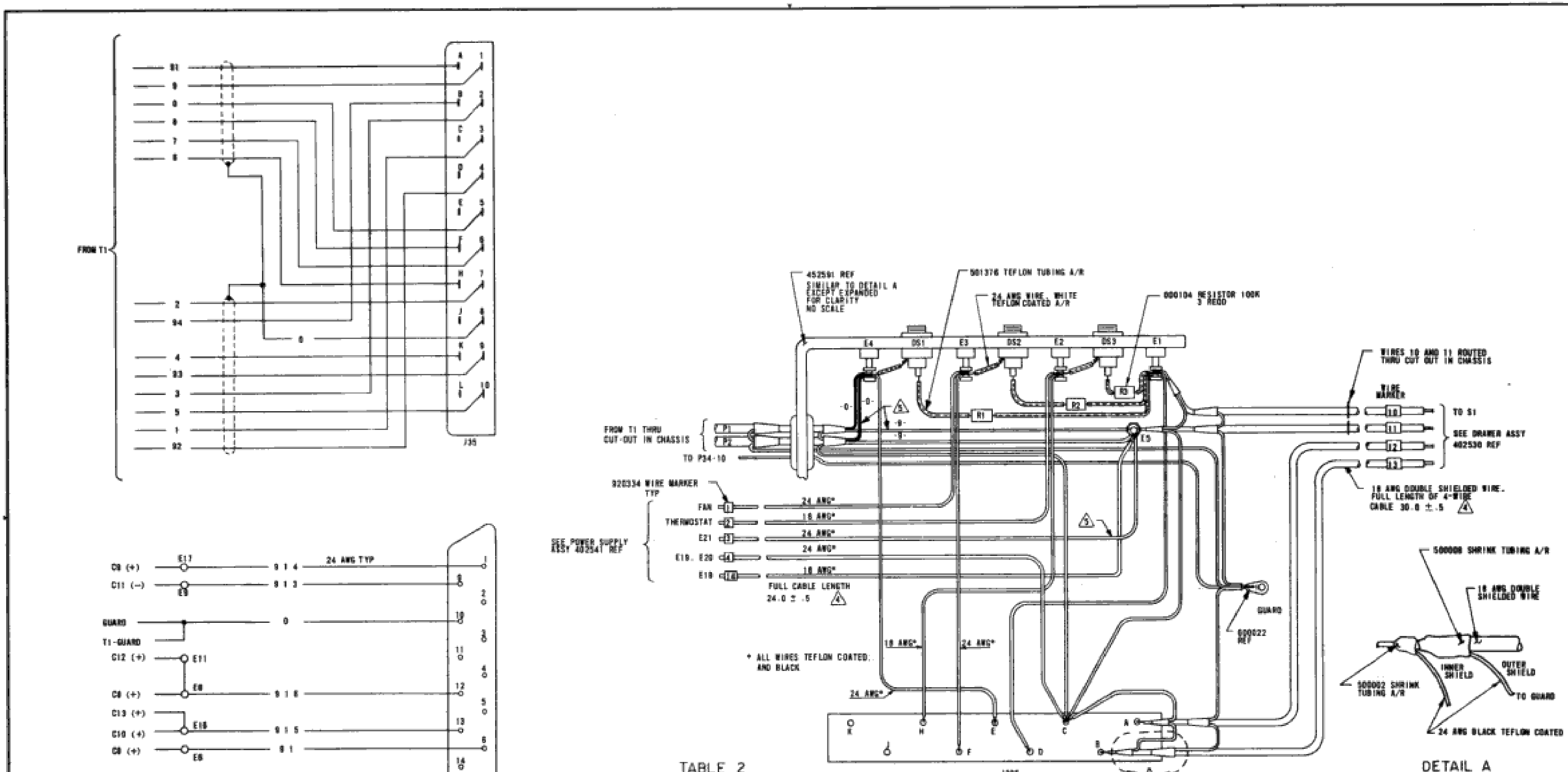
DRAWN · CHECK · DESIGN · PROJ ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

CHASSIS ASSY-
POWER SUPPLY

SIZE D | CODE IDENT NO. 21793 | DWG NO. 402685 | REV

SCALE 1/1 | WT | SHEET 1 OF 2



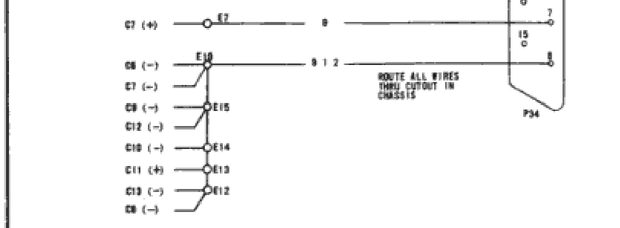


TABLE 2

DESCRIPTION	MARKER	P/N
24 AWG WIRE WHT TEFLON COATED		500043
24 AWG WIRE BLK TEFLON COATED	1,4	500058
18 AWG WIRE BLK TEFLON COATED	2,3,14	500052
18 AWG DOUBLE SHIELDED WIRE	10-13	500059
24 AWG WIRE 0		524000
9 1 2		524912
9 1 3		524913
9 1 4		524914
9 1 5		524915
9 1 8		524918
9 1		524919
24 AWG WIRE 9		524999

LIST OF MATERIAL OR PARTS LIST

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

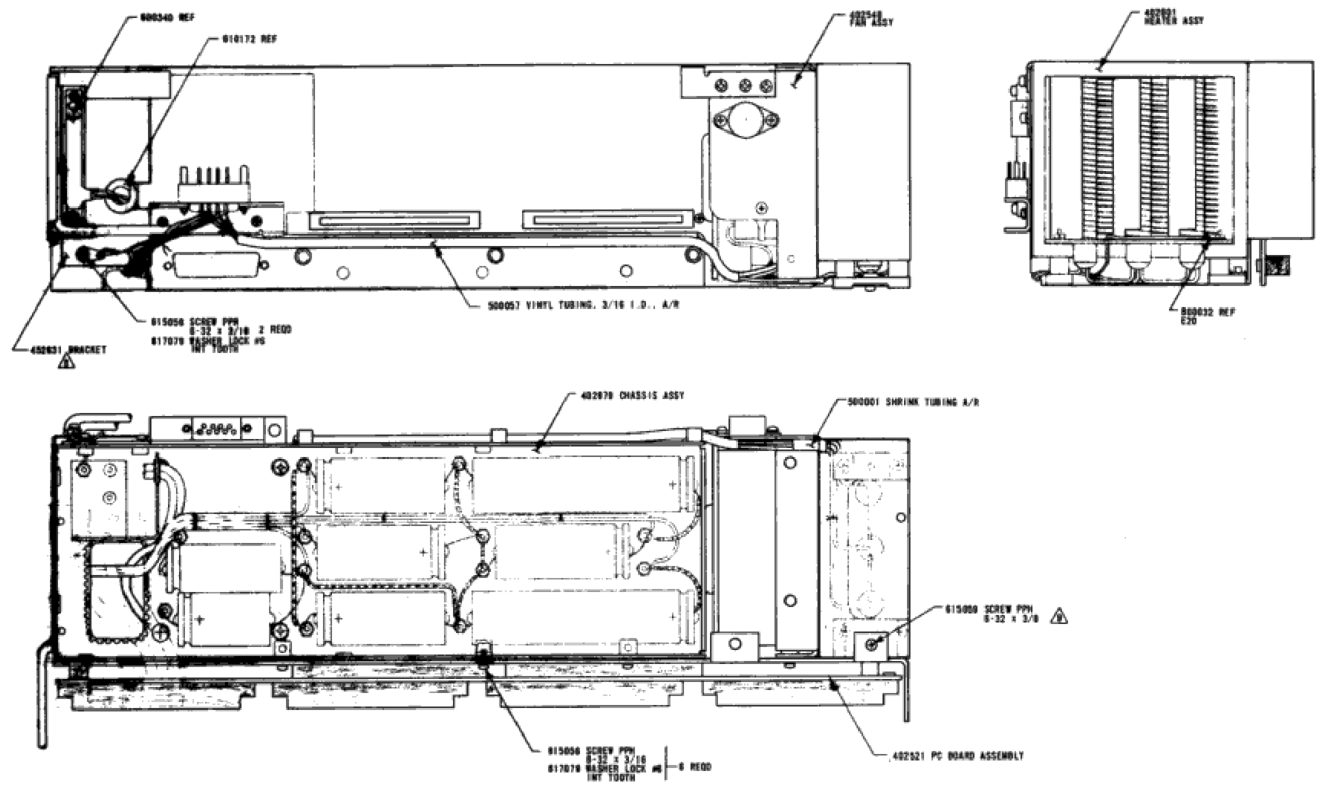
CHASSIS ASSY – POWER SUPPLY

NEXT ASSY	USED ON	NA	FA
402691	5524-STD	1	1
402691	5524-S2056	1	1

SIZE D | CODE IDENT NO. 21793 | DWG NO. 402685 | SHEET 2 OF 2

SEE SHEET 1

NOTES: UNLESS OTHERWISE SPECIFIED



6\. PRE-ASSEMBLE GROMMET (610172 REF), CONNECTOR (600340 REF), AND BRACKET (452631 REF) PRIOR TO ASSEMBLY

5\. CONNECTOR P34 FROM THE CHASSIS ASSEMBLY (402670 REF) TO BE PLUGGED INTO CONNECTOR J34 ON THE POWER SUPPLY BOARD ASSEMBLY. FASTEN CONNECTORS WITH HARDWARE BEFORE INSTALLATION OF POWER SUPPLY BOARD INTO THE INTERFACE ASSEMBLY CONNECTOR J29

4\. SEE SHEET 2 FOR WIRING DIAGRAM

3\. THERMOSTAT TERMINALS TO BE COVERED WITH SHRINK FIT TUBING, DANA P/N 500002.

2\. SCHEMATIC REF 430690 AND 430750

1\. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS

NOTES: UNLESS OTHERWISE SPECIFIED

10\. APPLY LOCKTITE PER APPLICATION SPECIFICATION 900075

9\. SCREW TO BE REMOVED ON NEXT ASSEMBLY

8\. WIRE NO. 23 TO BE ROUTED TO E18 WITH ENOUGH SERVICE LOOP TO ATTACH TO E18 FOR 115 VOLT WIRING

7\. HEX NUT TO BE REMOVED FOR INSTALLATION OF THE SOLDER LUG AND THEN REPLACED. RE-APPLY LOCTITE TO THREADS.

NEXT ASSY	USED ON	NA	FA
402 690	5524-S2056	1	1
402 690	5524-STD	1	1
APPLICATION		QTY REQD	

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X .XX .XXX; ANGLES 0° 30'; FORMED ANGLES

MATERIAL

FINISH

CONTRACT NO.

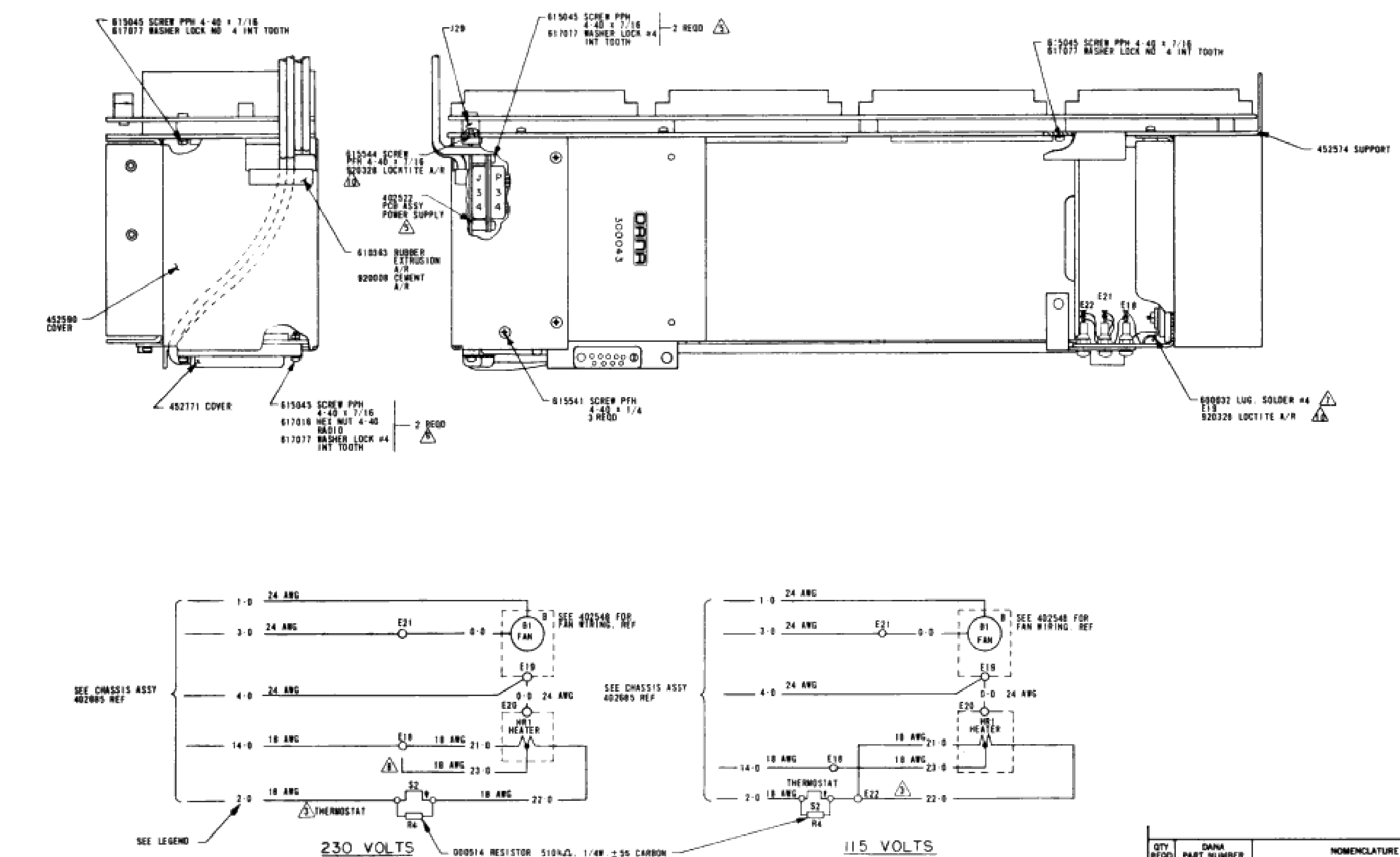
DRAWN / CHECK / DESIGN / PROJ ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ASSEMBLY — POWER SUPPLY

SIZE D | CODE IDENT NO. 21793 | DWG NO. 402691 | REV

SCALE 1/1 | WT | SHEET 1 OF 2



LEGEND

TABLE I

DESCRIPTION	PART NO
WIRE 18 AWG TEFLON	500052
WIRE 24 AWG TEFLON	500058

SEE SHEET 1

NOTES: UNLESS OTHERWISE SPECIFIED

NEXT ASSY	USED ON	NA	FA
402690	5524-32656	1	1
402690	5524-STD	1	1

APPLICATION | QTY REQD

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS ANGLES 0° 30' FORMED ANGLES

MATERIAL

FINISH

CONTRACT NO.

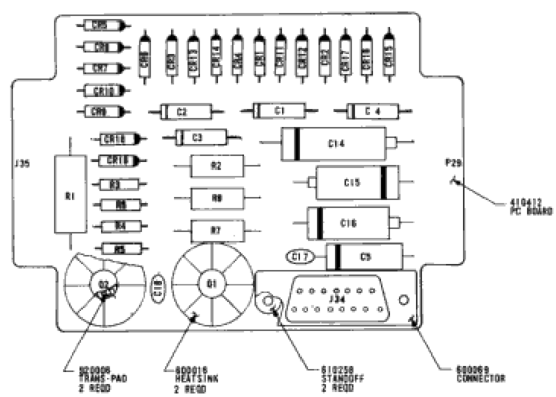
DRAWN · CHECK · DESIGN · PROD ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ASSEMBLY –
POWER SUPPLY

SIZE D · CODE IDENT NO. 21793 · DWG NO. 402691 · REV

SCALE 1/1 · WT · SHEET 2 OF 2



REF DES	PART NO.	DESCRIPTION
Q2	200011	009 PNP
Q1	200035	014 NPN
R8	030007	150 3W 1%
R7	030007	150 3W 1%
R6	000151	150
R5	000151	150
R4	000202	2k
R3	000202	2k
R2	030008	200 3W
R1	031450	220k 2W
CR19	220015	1N987B
CR18	220015	1N987B
CR17	210004	SD4
↑	↑	↑
THRU		
↓	↓	↓
CR1	210004	SD4
C18	101174	.001UF DISC
C17	101174	.001UF DISC
C16	110036	25UF 50V
C15	110036	25UF 50V
C14	110041	250UF 6V
C5	120072	.01UF 600V
C4	121068	.01UF 100V
C3	↑	↑
C2	↓	↓
C1	121068	.01UF 100V

NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE IN OHMS. 1/4W, ± 5% CARBON
2. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS
3. SCHEMATIC REFERENCE 430701

NEXT ASSY	USED ON	NA	FA
402691	5524-32656	1	1
402691	5524-STD	1	1
402541	5524	1	1
APPLICATION		QTY REQD	

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS ANGLES 0° 30' FORMED ANGLES

MATERIAL

FINISH

CONTRACT NO.

DRAWN Al Hanbury 5 SEPT 1967

CHECK

DESIGN

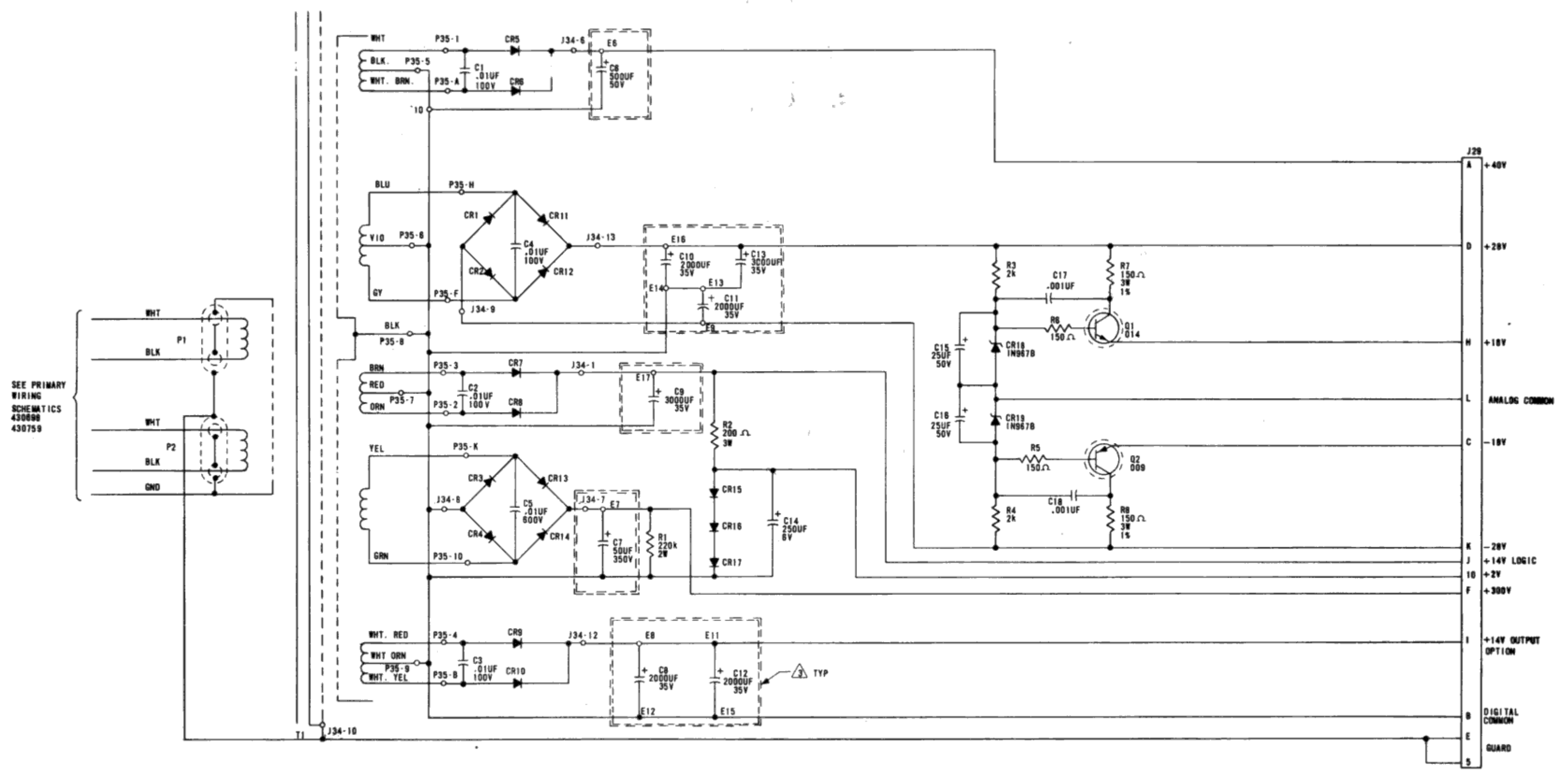
PROJ ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

PC BOARD ASSY — POWER SUPPLY

SIZE D | CODE IDENT NO. 21793 | DWG NO. 402522 | REV

SCALE 2/1 | WT | SHEET 1 OF 1



NOTES: UNLESS OTHERWISE SPECIFIED

1. ALL RESISTORS ARE IN OHMS, 1/4W, CARBON, ± 5%
2. ALL DIODES SD 4.
3. CAPACITORS NOT ON POWER SUPPLY BOARD

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
402685	~~5524-52056~~	REF	REF
402522	5524-52056	REF	REF
402685	5524-STD	REF	REF
402522	5524-STD	REF	REF
402679	5524	REF	REF
402522	5524	REF	REF
APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X .030 .XX .020 .XXX .010 ANGLES 0° 30' FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

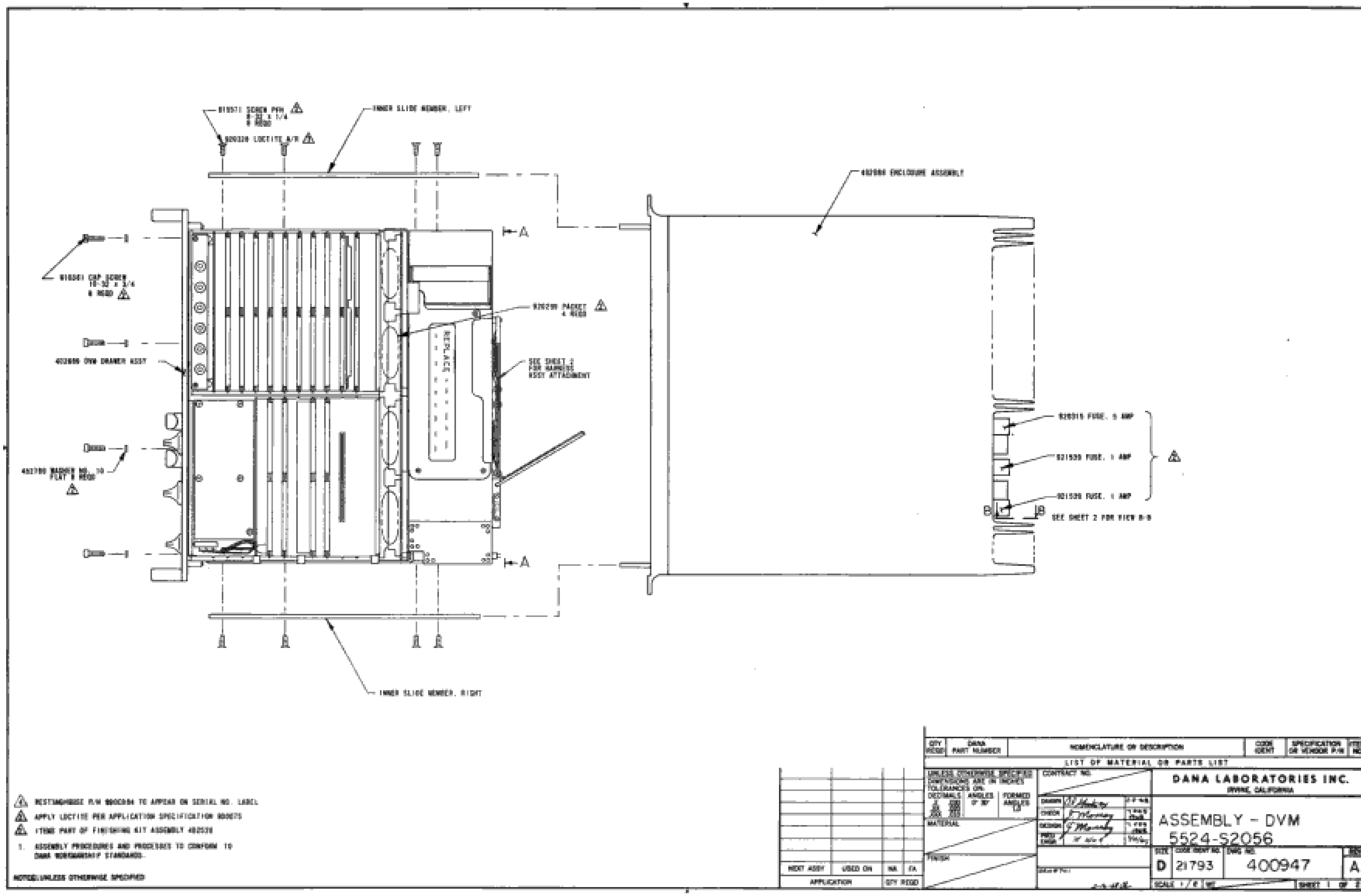
DRAWN Al [illegible] AUG 1968
CHECK J. Monroe 1968
DESIGN J. Monroe 1968
PROJ ENGR [illegible]

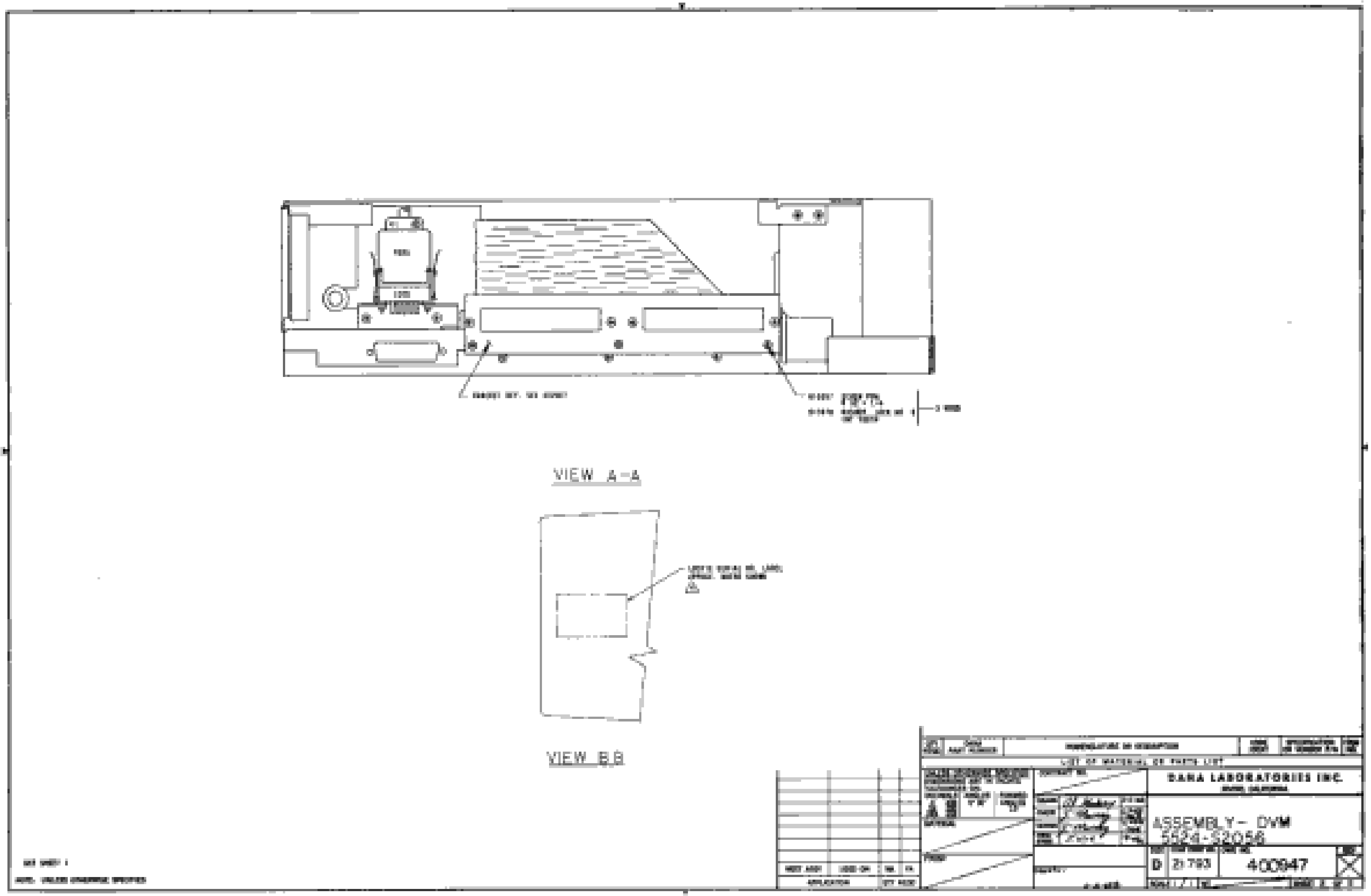
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

SCHEMATIC — POWER SUPPLY

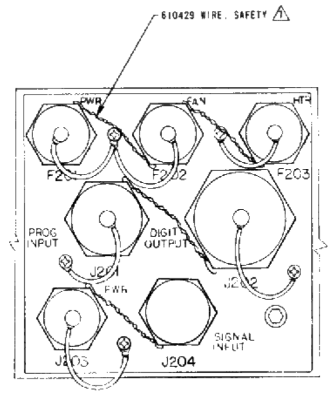
SIZE D | CODE IDENT NO. 21793 | DWG NO. 430701 | REV

SCALE NONE | WT | SHEET 1 OF 1

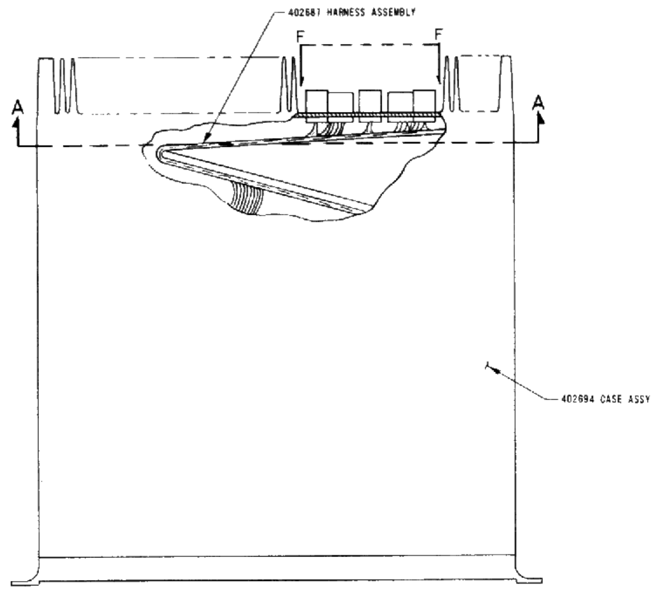

INNER SLIDE MEMBER, LEFT
ENCLOSURE ASSEMBLY
REPLACE
SEE SHEET 2 FOR HARNESS ASSY ATTACHMENT
INNER SLIDE MEMBER, RIGHT
SEE SHEET 2 FOR VIEW B-B
ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS.
NOTES: UNLESS OTHERWISE SPECIFIED
LIST OF MATERIAL OR PARTS LIST
DANA LABORATORIES INC.
IRVINE, CALIFORNIA
ASSEMBLY - DVM
5524-S2056
D
21793
400947
A



VIEW A-A
VIEW B-B
DANA LABORATORIES INC.
ASSEMBLY - DVM
5524-52056
D
21793
400947



VIEW F-F
SCALE 1/1
REAR VIEW



TOP VIEW

8. PLUG TO BE SEATED FLUSH WITH PLATE
7. SAFETY WIRE PER MS20995C32 GROUP AS SHOWN
6. INSTALL SPACER UNDER NEOPRENE SEAL ONLY ON THE CONDITION THAT THE COVER DOES NOT SEAT TIGHT AGAINST CONNECTOR OR SEAL. SEE DETAIL E
5. ALL JAM NUTS TO BE TIGHTENED TO SPECIFIED TORQUE VALUE IN TABLE 1
4. COVER ENTIRE TOP SURFACE OF RFI FILTER WITH MYLAR TAPE. DANA P/N 920321 REF
3. APPLY SILICONE COMPOUND DANA P/N 920337 REF TO O-RING BEFORE INSTALLATION
2. APPLY LOCTITE PER APPLICATION SPECIFICATION 900075
1 ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
400941	5524 52056	1	1

APPLICATION | QTY REQD

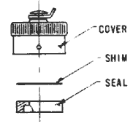
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS .X .030, .XX .020, .XXX .010 — ANGLES 0° 30' — FORMED ANGLES 1.0
MATERIAL
FINISH

CONTRACT NO.
DRAWN — CHECK — DESIGN — PROJ ENGR

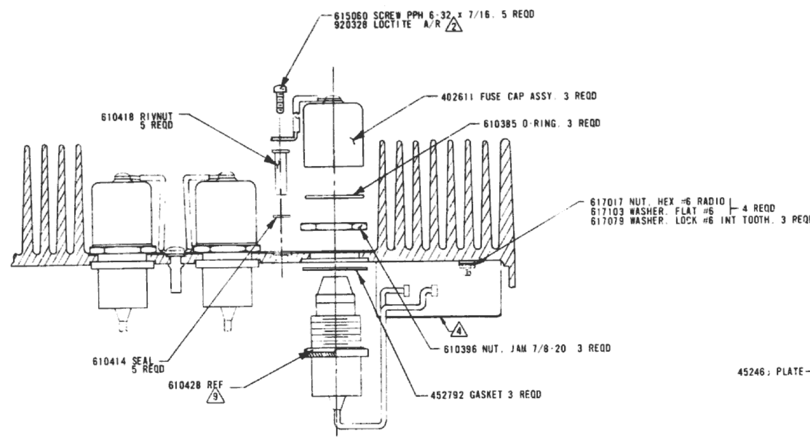
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ASSEMBLY-ENCLOSURE

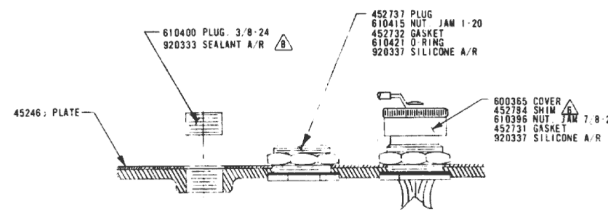
SIZE D | CODE IDENT NO. 21793 | DWG NO. 402686 | REV
SCALE 1/2 | WT | SHEET 1 OF 2



DETAIL E
SCALE: NONE
TYP 4 PLACES



SECTION D-D



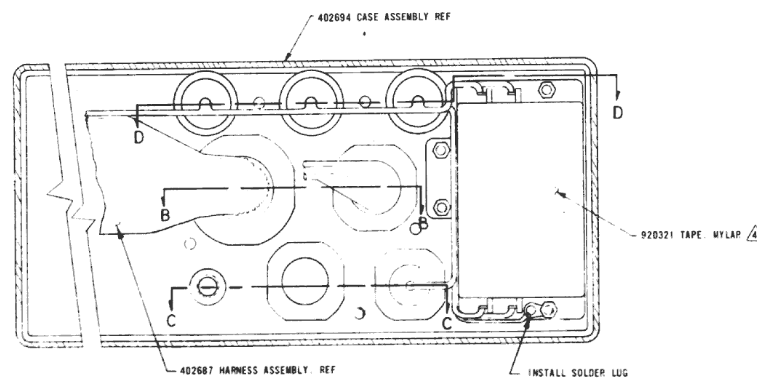
SECTION C-C

TABLE 1

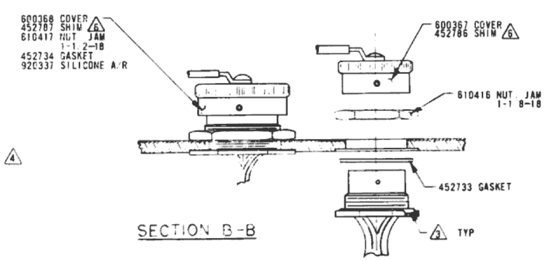
CONN NO	TORQUE, FT-LB	
J201	22 MIN	33 MAX
J202	30 "	45 "
J203	14 "	21 "
J204	16 "	24 "
F201	14 "	21 "
F202	14 "	21 "
F203	14 "	21

TABLE 2

O-RING REPLACEMENT	
PART NO	SHELL SIZE
410420	12 (J203)
410421	14 (J204)
410422	16 (J201)
410423	22 (J202)



SECTION A-A



SECTION B-B

SEE SHEET 1
NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

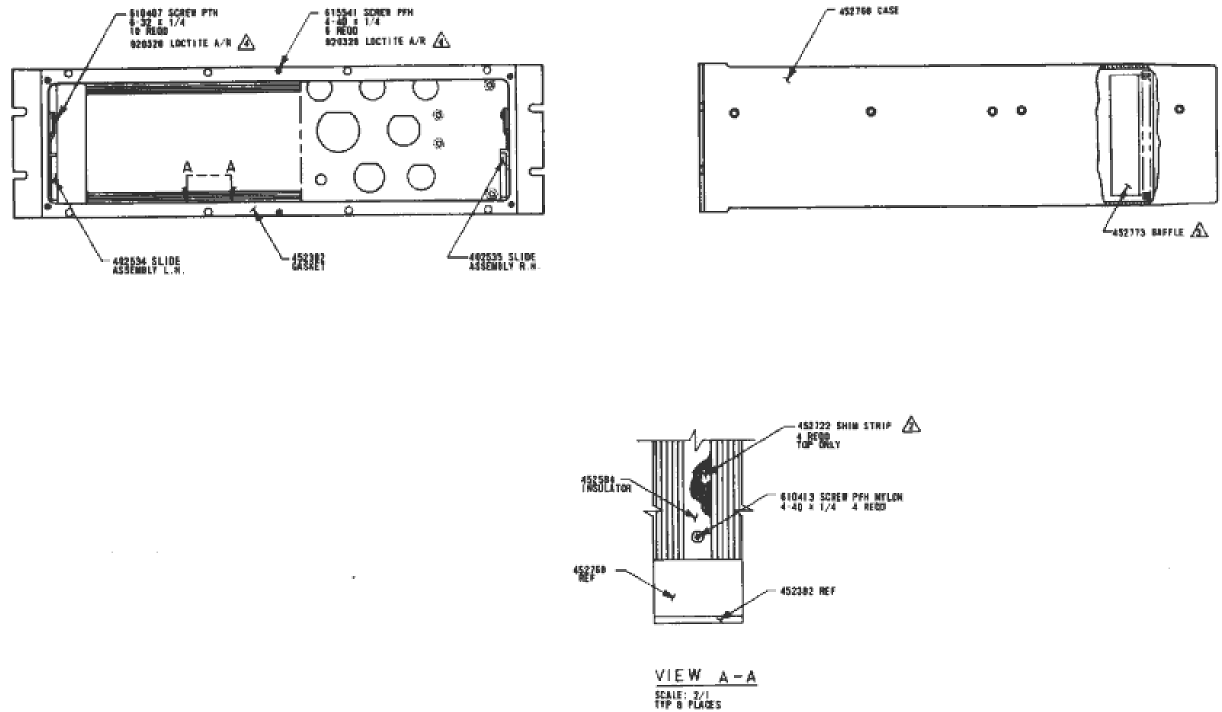
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X .030 .XX .020 .XXX .010 ANGLES 0° 30' FORMED ANGLES 1.0
MATERIAL
FINISH
CONTRACT NO.
DRAWN W. Hadley 31 JAN 1968
CHECK J. Morey 31 JAN 1968
DESIGN J. Morey 31 JAN 1968
PROJ ENGR J.S.C. 2-6-68

400947	5524-52056	1	1
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ASSEMBLY-ENCLOSURE

SIZE D | CODE IDENT NO. 21793 | DWG NO. 402686 | REV
SCALE 1/1 | WT | SHEET 2 OF 2



NOTES: UNLESS OTHERWISE SPECIFIED

1. ASSEMBLY PROCESSES AND PROCEDURES TO CONFORM TO DANA WORKMANSHIP STANDARDS
2. SEE NEXT ASSEMBLY FOR SHIM STRIP OPTION
3. INSTALL RUBBER BAFFLE ON TO REAR PLATE ON FINS.
4. APPLY LOCTITE PER APPLICATION SPECIFICATION 900075

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
402686	5524-57056	1	1

APPLICATION — QTY REQD

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS ANGLES 0° 30' FORMED ANGLES

MATERIAL

FINISH

CONTRACT NO.

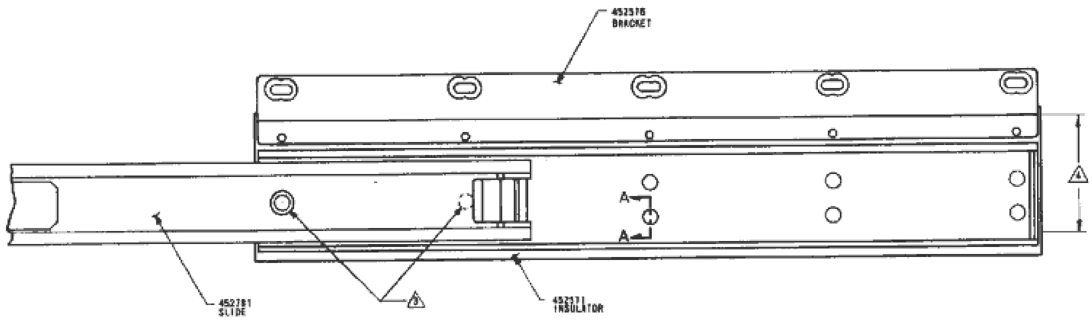
DRAWN Al ... CHECK J. Monroe DESIGN J. Monroe PROJ ENGR

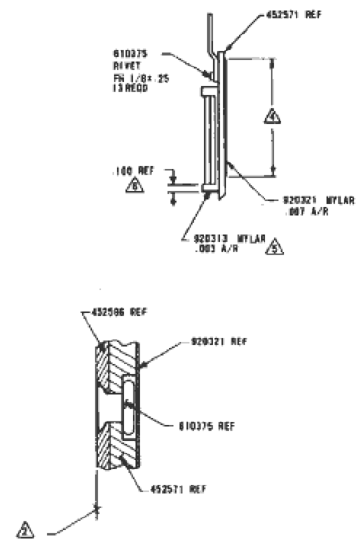
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ASSEMBLY - CASE

SIZE D | CODE IDENT NO. 21793 | DWG NO. 402694 | REV

SCALE 1/2 | WT | SHEET 1 OF 1





SECTION A-A

SCALE: 4/1
TYP 8 PLACES

P/N	DESCRIPTION		SLIDE P/N
402534	ASSY-SLIDE LEFT	SHOWN	452781
402535	ASSY-SLIDE RIGHT	OPPOSITE	452780

6. .100 THICK EDGE OF SLIDE ALWAYS NEAREST BOTTOM EDGE OF INSULATOR
5. MYLAR TAPE (P/N 920313 REF) TO EXTEND LENGTH OF BOTTOM SURFACE OF SLIDE AND TO BE TRIMMED FLUSH WITH ALL EDGES
4. MYLAR TAPE (P/N 920321 REF) TO EXTEND LENGTH OF INSULATOR AND COVER ALL RIVET HEADS IN AREA INDICATED. AND NOT TO EXTEND PAST EDGES
3. ALIGN CLEARANCE HOLE IN SLIDE WITH HOLE IN INSULATOR TO INSTALL RIVETS
2. FORMED PART OF RIVET NOT TO EXTEND BEYOND SURFACE DESIGNATED
1. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS

NOTES: UNLESS OTHERWISE SPECIFIED

402534				402535			
402694	5524-52056	1	1	402694	5524-52056	1	1
402532	5524-STD	1	1	402532	5524-STD	1	1
402682	5524	1	1	402532	5524	1	1
NEXT ASSY	USED ON	NA	FA	NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD		APPLICATION		QTY REQD	

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON: DECIMALS .X .XX .XXX; ANGLES 0° 30'; FORMED ANGLES

MATERIAL

FINISH

CONTRACT NO.

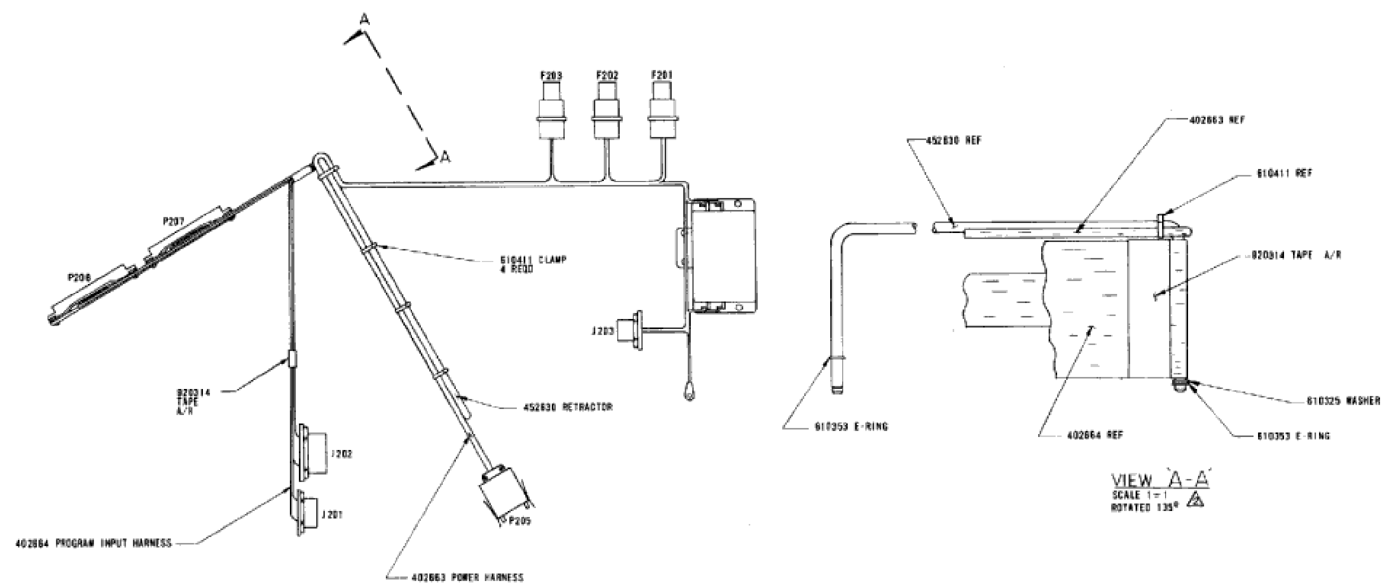
DRAWN: Q. Bailey — 30 OCT 67
CHECK: J. Money — 23 JAN 68
DESIGN: J. Money — 16 JAN 68
PROJ ENGR: ... — 2-1-68

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ASSEMBLY-SLIDE

SIZE: D | CODE IDENT NO.: 21793 | DWG NO: 402534 / 402535 | REV

SCALE 1/1 | WT | SHEET 1 OF 1



QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
402684	5524-S2056	1	1
402697	5524-S10	1	1

APPLICATION — QTY REQD

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X .030 .XX .020 .XXX .010 ANGLES 0° 30' FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

DRAWN
CHECK
DESIGN
PROJ. ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ASSY-WIRING HARNESS

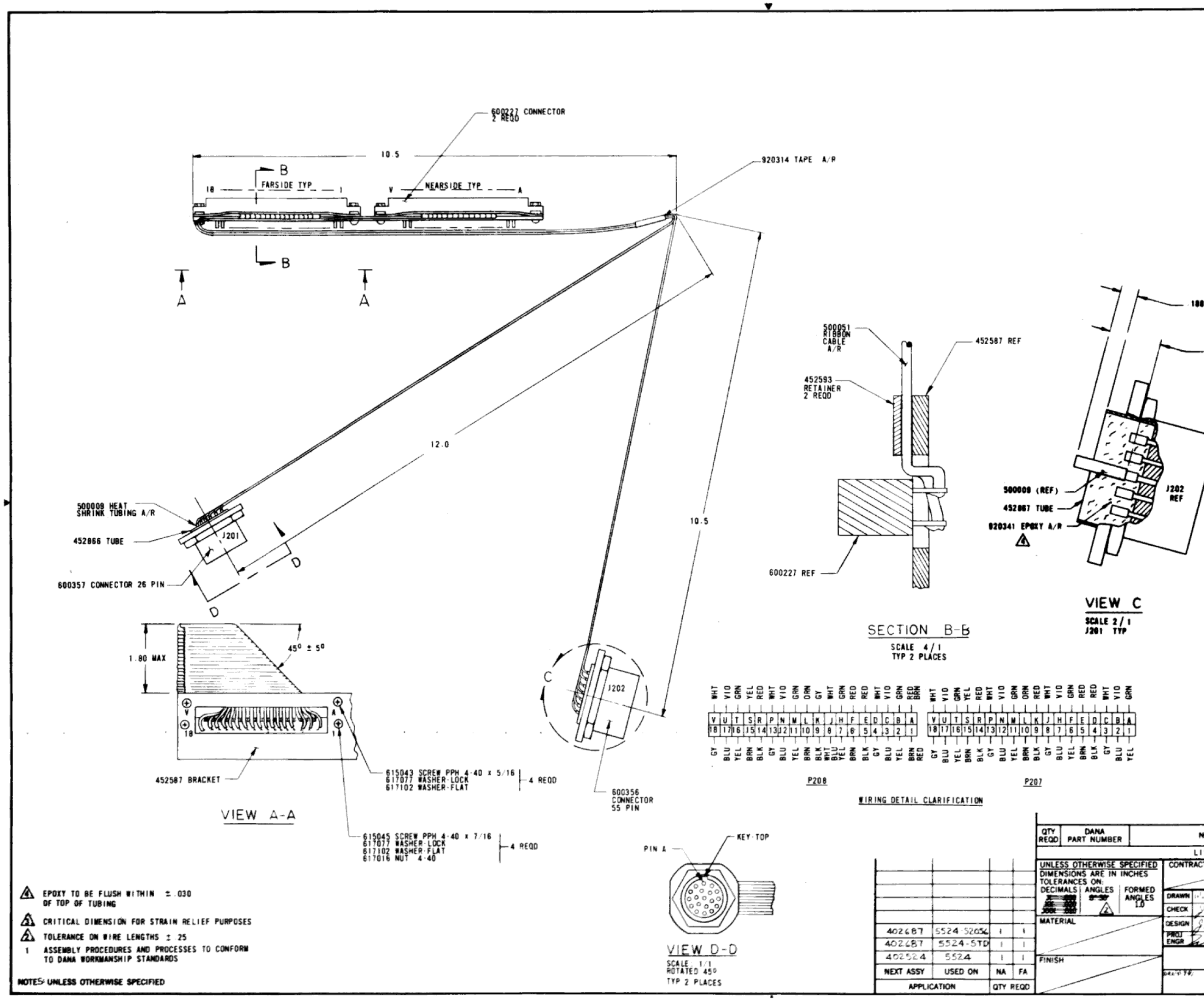
SIZE D | CODE IDENT NO. 21793 | DWG NO. 402687 | REV

SCALE 1/2 | WT | SHEET 1 OF 1

⚠ ALL CABLE ASSEMBLIES TO BE WRAPPED AROUND RETRACTOR IN PRE-FORMED BEND

1. ASSEMBLY AND PROCEDURES TO CONFORM TO DANA WORKMANSHIP STANDARDS

NOTES: UNLESS OTHERWISE SPECIFIED



NOTES: UNLESS OTHERWISE SPECIFIED

1. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS
2. TOLERANCE ON WIRE LENGTHS ± .25
3. CRITICAL DIMENSION FOR STRAIN RELIEF PURPOSES
4. EPOXY TO BE FLUSH WITHIN ± .030 OF TOP OF TUBING

P/N	DESCRIPTION	QTY	REF DES OR ITEM	P/N	DESCRIPTION	QTY
452587	BRACKET-CONN MTG	1		615043	SCREW PPH 4-40 X 5/16	4
452593	RETAINER-STRAIN RELIEF	2		615045	SCREW PPH 4-40 X 7/16	4
452866	TUBE-STRAIN RELIEF NO 16	1		617016	HEX NUT-4-40 RADIO	4
452867	TUBE-STRAIN RELIEF NO 22	1		617077	WASHER INT LOCK 4	8
500009	TUBING SHRINK	A/R		617102	WASHER-FLAT, LIGHT SERIES 4 STLS	8
500051	CABLE-RIBBON	A/R				
600227	CONN-18 PIN EDGE	2		920020	SOLDER-WIRE	A/R
600356	CONNECTOR HERMETIC	1		920314	TAPE-TEFLON	A/R
600357	CONNECTOR HERMETIC	1		920341	EPOXY-THIN	A/R

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
402687	5524-5205	1	1
402687	5524-STD	1	1
402524	5524	1	1

APPLICATION — QTY REQD

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS ANGLES FORMED ANGLES ±1.0

MATERIAL

FINISH

CONTRACT NO.

DRAWN · CHECK · DESIGN · PROJ ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

HARNESS ASSY-PROGRAM INPUT AND DIGITAL OUTPUT

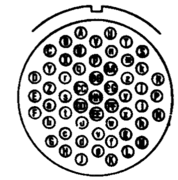
SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	402664	C

SCALE 1/1 · WT · SHEET 1 OF 2

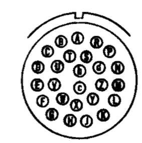
FUNCTION	J202 PIN	WIRE COLOR	CONN-PIN
RANGE (X1)	HH	VIO	P207-B
(X2)	GG	VIO	H
(X3)	FF	WHT	C
(X4)	EE	GY	P207-3
RANGE (X5)	DD	YEL	P208-7
POLARITY (X1)	CC	GRN	P207-F
(X2)	BB	YEL	1
(X3)	AA	GRN	A
POLARITY (X4)	z	BLU	2
UNITS (X1)	y	RED	E
(X2)	x	RED	D
(X3)	w	WHT	J
UNITS (X4)	v	BLU	7
10's (X1)	u	BLK	4
(X2)	t	BRN	5
(X3)	s	YEL	6
10's (X4)	r	RED	K
100's (X1)	q	GY	8
(X2)	p	GRN	15
(X3)	n	GRN	M
100's (X4)	m	YEL	11
1000's (X1)	k	BLK	9
(X2)	j	ORN	L
(X3)	i	BRN	10
1000's (X4)	h	BLK	14
10K's (X1)	g	BLU	12
(X2)	f	RED	R
(X3)	e	GY	13
10K's (X4)	d	GRN	T
100K's (X1)	c	WHT	P
(X2)	b	WHT	V
(X3)	a	BLU	17
100K's (X4)	Z	GY	P207-18
FUNCTION (X1)	Y	WHT	P208-J
(X2)	X	GY	K
(X3)	W	GRN	H
FUNCTION (X4)	V	BRN	6
PRINT COMMAND	U	WHT	P209-8
EXTERNAL SUPPLY	T	VIO	P207-U
COMMON	S	RED	P208-1

FUNCTION	J202 PIN	WIRE COLOR	CONN-PIN
10's COMMON	R	RED	P208-F
1000's COMMON	P	RED	E
POL COMMON	N	BLK	5
UNITS COMMON	M	GY	4
10K's COMMON	L	WHT	D
100's COMMON	K	BLU	3
100K's COMMON	J	VIO	C
RANGE COMMON	H	YEL	2
FUNCT COMMON	G	GRN	B
COMMON	F	BRN	1
COMMON	E	RED	P208-A
SPARE	D	YEL	P207-16
SPARE	C	YEL	P207-S
SPARE	B	VIO	P207-N

FUNCTION	J201 PIN	WIRE COLOR	CONN-PIN
1 RANGE	Y	GRN	P208 M
10	W	VIO	N
100	L	YEL	S
1000	K	GRN	T
10000 RANGE	J	VIO	U
RATIO	G	RED	R
DC FAST	H	WHT	P
DC	V	GY	13
AC	X	BRN	10
MV	D	BLU	12
K OHMS	F	BLK	14
HOLD	U	BLK	9
COMMAND	P	YEL	16
DELAYED COMMAND	M	YEL	11
EXT REF	R	ORN	L
COMMON	B	BRN	A
+12V	N	BRN	15
PRINT COMMAND	c	BLU	P208-8
SPARE	A	BLU	P208-17
SPARE	C	GY	P208-18
SPARE	E	WHT	P208-V



J202



J201

NEXT ASSY	USED ON	NA	FA
402687	5524-S2056	1	1
402687	5524-STD	1	1
402524	5524	1	1

APPLICATION | QTY REQD

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS ANGLES FORMED ANGLES

MATERIAL

FINISH

CONTRACT NO.

DRAWN W. L. Wright 12-1967
CHECK J. Monroy 8 JAN 1968
DESIGN J. Monroy 2 JAN 1968
PROJ ENGR

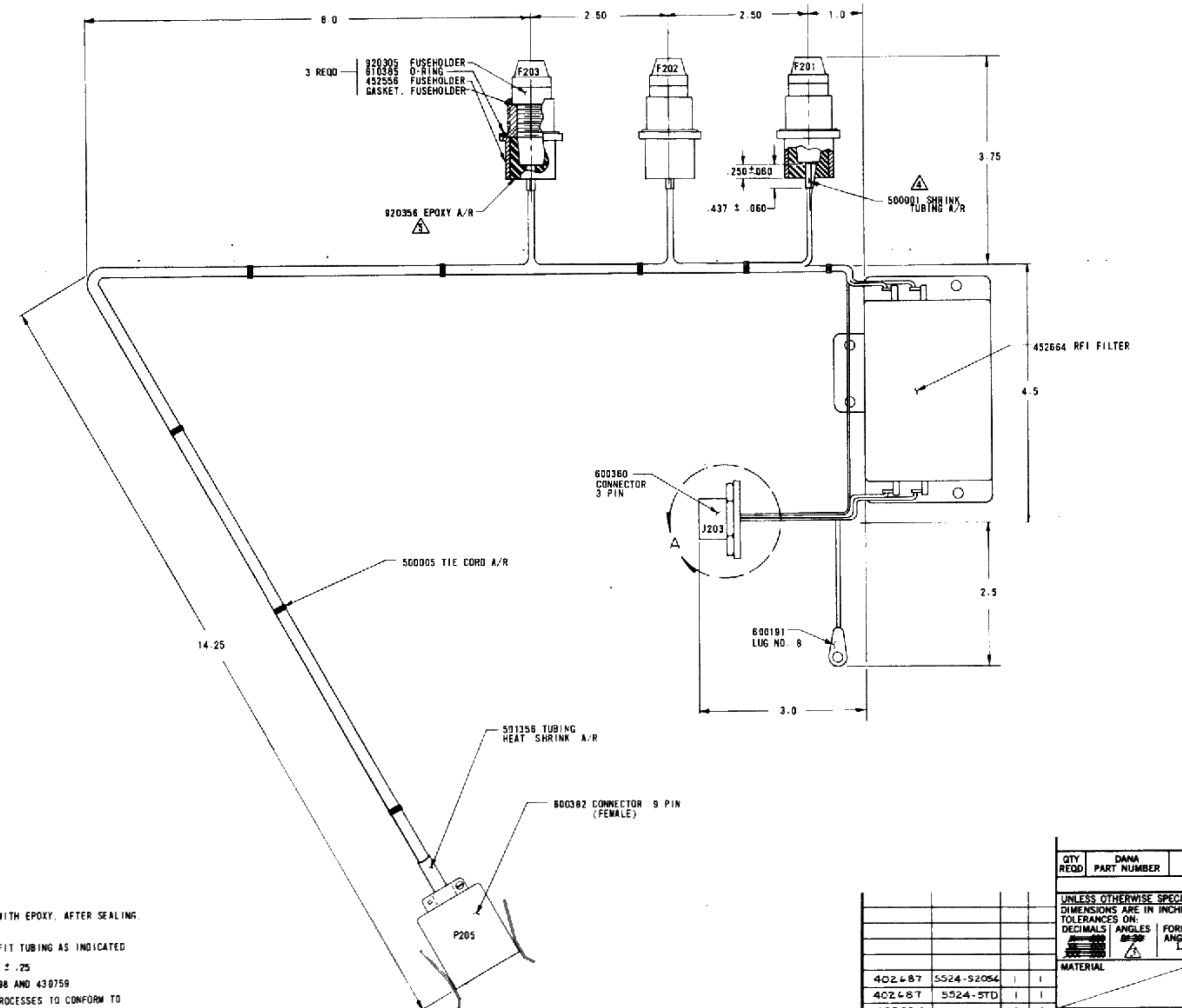
DANA LABORATORIES INC.
IRVINE, CALIFORNIA

HARNESS ASSY-PROGRAM INPUT AND DIGITAL OUTPUT

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	402664	

SCALE NONE | WT | SHEET 2 OF 2

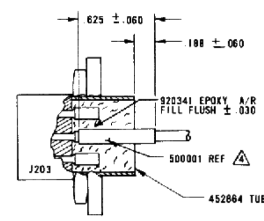
NOTES: UNLESS OTHERWISE SPECIFIED



WIRING DIAGRAM

FUNCTION	P205 PIN	WIRE COLOR	CONN-PIN	WIRE P/N
POWER	A	BLK	RFI- FILTER	500052
POWER	B	BLK	RFI- FILTER	500052
GROUND	C	BLK	J203-C	500058
COMMON POWER	D	BLK	F201, F202, F203	500052
UNIT POWER	E	BLK	F201	500058
FAN POWER	F	BLK	F202	500058
HEATER POWER	H	BLK	F203	500052

FUNCTION	J203 PIN	WIRE COLOR	CONN-PIN	WIRE P/N
POWER	A	BLK	RFI- FILTER	500058
POWER	B	WHT	RFI- FILTER	500058
GND	C	BLK	#8 SOLDER LUG	500059



VIEW A

SCALE 2/1

NOTES: UNLESS OTHERWISE SPECIFIED

1. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS
2. SCHEMATIC REFERENCE: 430698 AND 430759
3. TOLERANCE ON WIRE LENGTHS ± .25
4. ALL WIRES TO HAVE SHRINK FIT TUBING AS INDICATED
5. FUSEHOLDERS TO BE FILLED WITH EPOXY, AFTER SEALING FLUSH ± .030

NEXT ASSY	USED ON	NA	FA
402687	5524-S2054	1	1
402687	5524-STD	1	1
402524	5524	1	1

APPLICATION — QTY REQD

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS | ANGLES | FORMED ANGLES

MATERIAL

FINISH

CONTRACT NO.

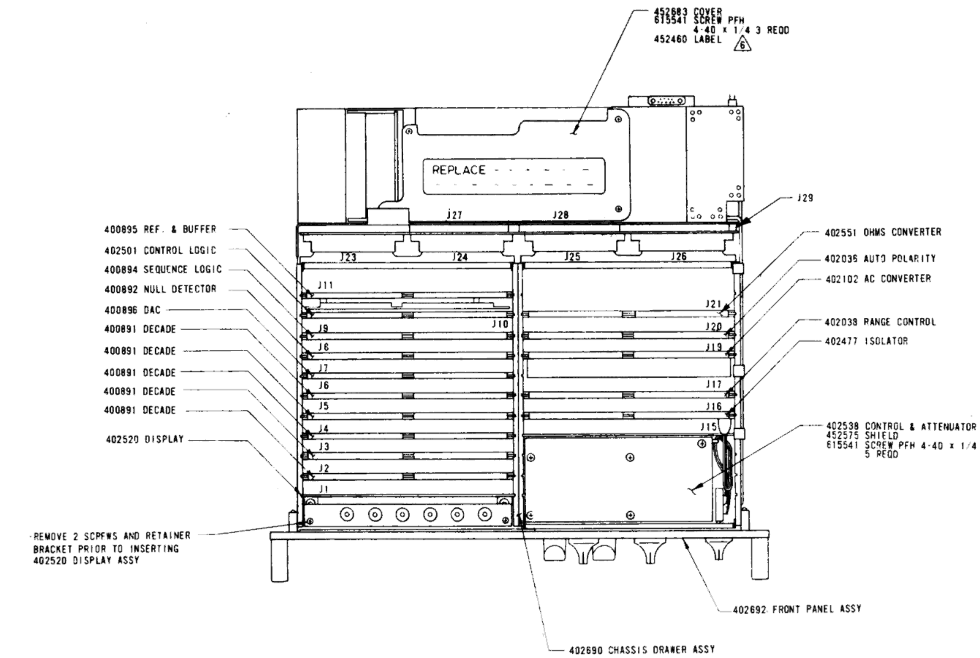
DRAWN · CHECK J. Money 4 JAN 1968 · DESIGN J. Money 4 JAN 1968 · PROJ ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

HARNESS ASSY-POWER

SIZE D · CODE IDENT NO. 21793 · DWG NO. 402663 · REV B

SCALE 1/1 · WT · SHEET 1 OF 1



6. LABEL TO BE CENTERED ON COVER
5. APPLY LOCTITE PER APPLICATION SPECIFICATION 900075
4. HARDWARE USED TO RETAIN CONTROL AND ATTENUATOR ASSEMBLY (402538 REF) AND DISPLAY BOARD ASSEMBLY (402520 REF)
3. FIBER OPTICS TO BE ROUTED DIRECTLY TO FRONT PANEL DO NOT INTERCHANGE POSITIONS
2. SEE SHEET 3 FOR WIRING DIAGRAM
1. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM WITH DANA WORKMANSHIP STANDARDS

NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
400947	5524-52056	1	1

APPLICATION | QTY REQD

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON:
DECIMALS .X .030, .XX .020, .XXX .010 | ANGLES 0° 30' | FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

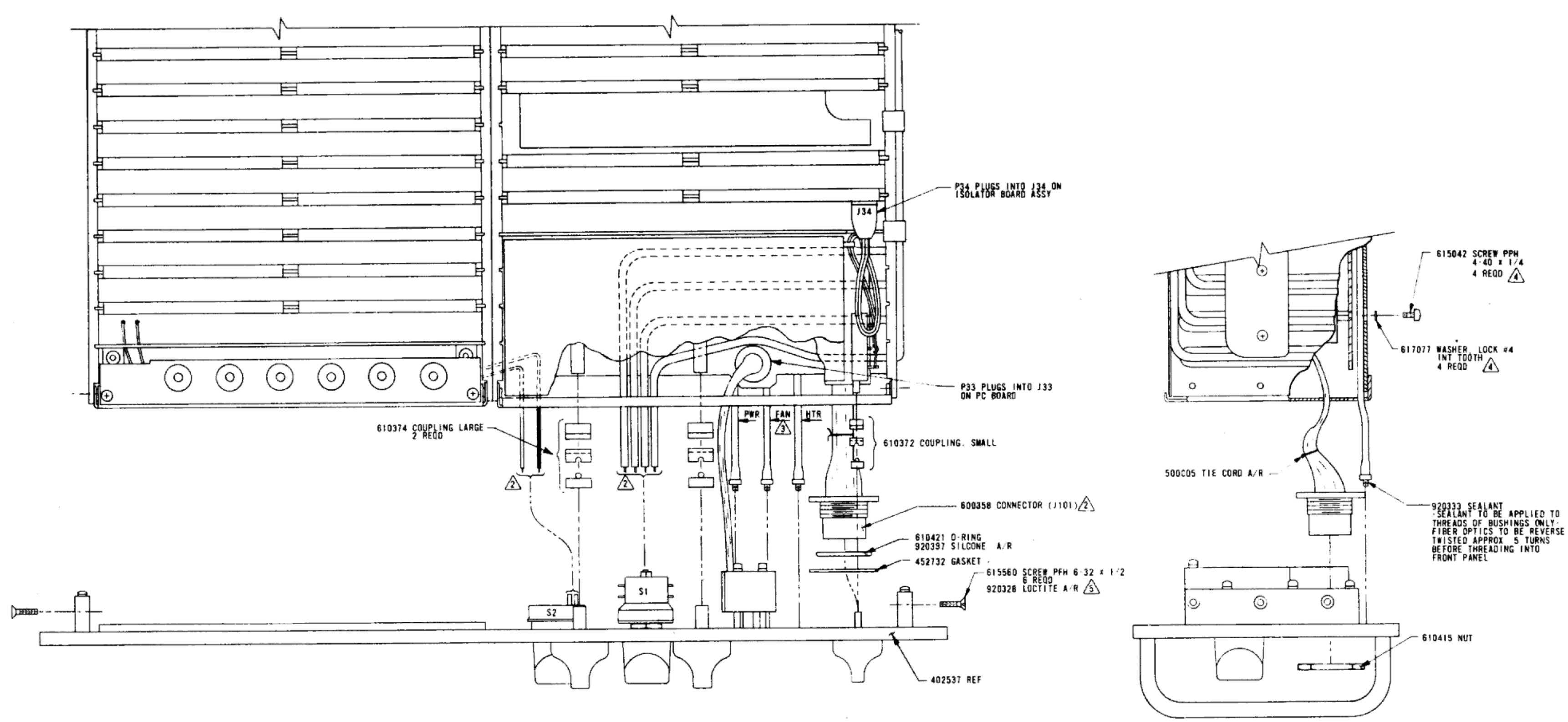
DRAWN | CHECK | DESIGN | PROJ ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ASSY-DRAWER DVM

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	402689	

SCALE 1/2 | WT | SHEET 1 OF 3



QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X .XX .XXX | ANGLES 0° 30' | FORMED ANGLES

MATERIAL

FINISH

CONTRACT NO.

DRAWN: Al Forbes 30 JAN 68
CHECK: J. Money 30 JAN 1968
DESIGN: J. Money 30 JAN 1968
PROJ ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ASSY-DRAWER DVM

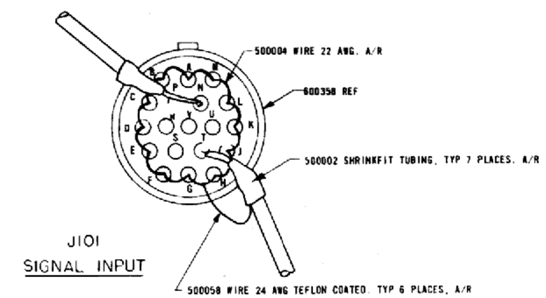
SIZE	CODE IDENT NO	DWG NO.	REV
D	21793	402689	

SCALE 1/1 | WT | SHEET 2 OF 3

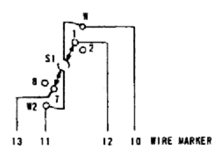
NEXT ASSY	USED ON	NA	FA
400947	5524-S2056	1	1
APPLICATION		QTY REQD	

SEE SHEET 1

NOTES: UNLESS OTHERWISE SPECIFIED

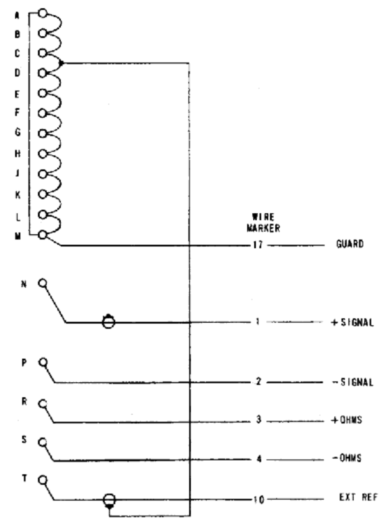


J101
SIGNAL INPUT



S1 POWER
WIRING DIAGRAM

S2 MODE
WIRING DIAGRAM



J101
WIRING DIAGRAM

REF (T)
+Ω (R)
-Ω (S)
V IN (N)
V COM (P)

SEE SHEET 1
NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X .XX .XXX; ANGLES 0° 30'; FORMED ANGLES

MATERIAL

FINISH

CONTRACT NO.

DRAWN Al Fobey
CHECK J. Monroe
DESIGN J. Monroe
PROJ ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

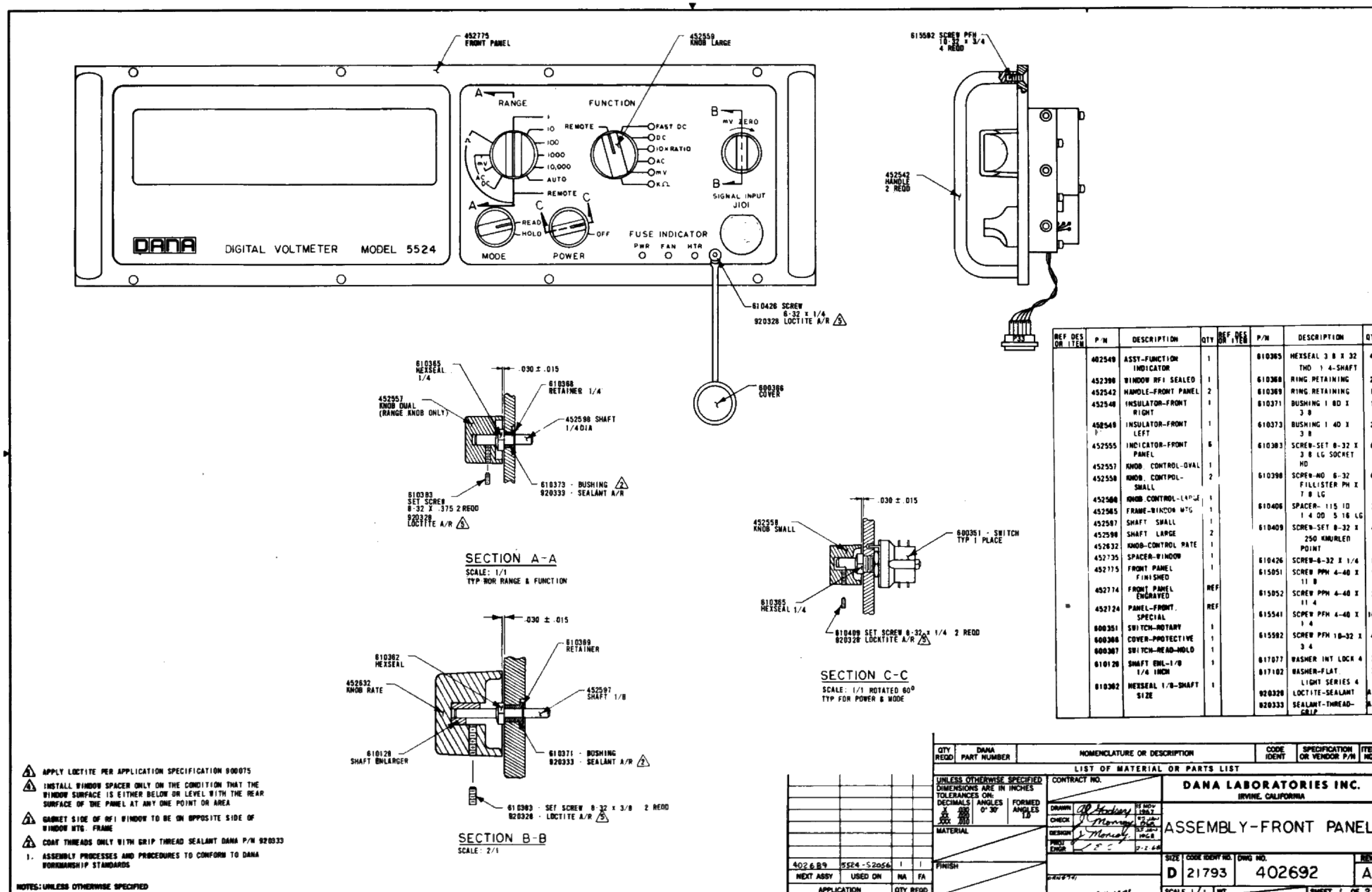
ASSY-DRAWER DVM

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	402689	

SCALE NONE | WT | SHEET 3 OF 3

NEXT ASSY	USED ON	NA	FA
400947		1	1

APPLICATION | QTY REQD



REF DES OR ITEM	P/N	DESCRIPTION	QTY	REF DES OR ITEM	P/N	DESCRIPTION	QTY
	402549	ASSY-FUNCTION INDICATOR	1		610365	HEXSEAL 3 8 X 32 THD 1 4-SHAFT	4
	452390	WINDOW RFI SEALED	1		610368	RING RETAINING	2
	452542	HANDLE-FRONT PANEL	2		610369	RING RETAINING	1
	452548	INSULATOR-FRONT RIGHT	1		610371	BUSHING 1 8D X 3 8	1
	452549	INSULATOR-FRONT LEFT	1		610373	BUSHING 1 4D X 3 8	2
	452555	INDICATOR-FRONT PANEL	6		610383	SCREW-SET 8-32 X 3 8 LG SOCKET HD	6
	452557	KNOB, CONTROL-OVAL	1				
	452558	KNOB, CONTROL-SMALL	2		610398	SCREW-NO 6-32 FILLISTER PH X 7 8 LG	6
	452560	KNOB CONTROL-LARGE	1				
	452565	FRAME-WINDOW MTG	1		610406	SPACER- 115 ID 1 4 OD 5 16 LG	3
	452597	SHAFT SMALL	1				
	452598	SHAFT LARGE	2		610409	SCREW-SET 8-32 X 250 KNURLED POINT	4
	452632	KNOB-CONTROL RATE	1				
	452735	SPACER-WINDOW	1		610426	SCREW-6-32 X 1/4	1
	452775	FRONT PANEL FINISHED	1		615051	SCREW PPH 4-40 X 11 8	1
	452774	FRONT PANEL ENGRAVED	REF		615052	SCREW PPH 4-40 X 11 4	2
	452724	PANEL-FRONT, SPECIAL	REF		615541	SCREW PFH 4-40 X 1 4	16
	600351	SWITCH-ROTARY	1		615592	SCREW PFH 10-32 X 3 4	4
	600386	COVER-PROTECTIVE	1				
	600387	SWITCH-READ-HOLD	1				
	610128	SHAFT ENL-1/8 1/4 INCH	1		617077	WASHER INT LOCK 4	3
					617102	WASHER-FLAT LIGHT SERIES 4	3
	610302	HEXSEAL 1/8-SHAFT SIZE	1		920328	LOCTITE-SEALANT	A/R
					920333	SEALANT-THREAD-GRIP	A/R

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

1. APPLY LOCTITE PER APPLICATION SPECIFICATION 900075
2. INSTALL WINDOW SPACER ONLY ON THE CONDITION THAT THE WINDOW SURFACE IS EITHER BELOW OR LEVEL WITH THE REAR SURFACE OF THE PANEL AT ANY ONE POINT OR AREA
3. GASKET SIDE OF RFI WINDOW TO BE ON OPPOSITE SIDE OF WINDOW MTG. FRAME
4. COAT THREADS ONLY WITH GRIP THREAD SEALANT DANA P/N 920333
5. ASSEMBLY PROCESSES AND PROCEDURES TO CONFORM TO DANA WORKMANSHIP STANDARDS

NOTES: UNLESS OTHERWISE SPECIFIED

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X ±.030 .XX ±.020 .XXX ±.010 ANGLES 0° 30' FORMED ANGLES 1.0

MATERIAL

FINISH

402689	5524-S2056	1	1
NEXT ASSY	USED ON	NA	FA
APPLICATION		QTY REQD	

CONTRACT NO.

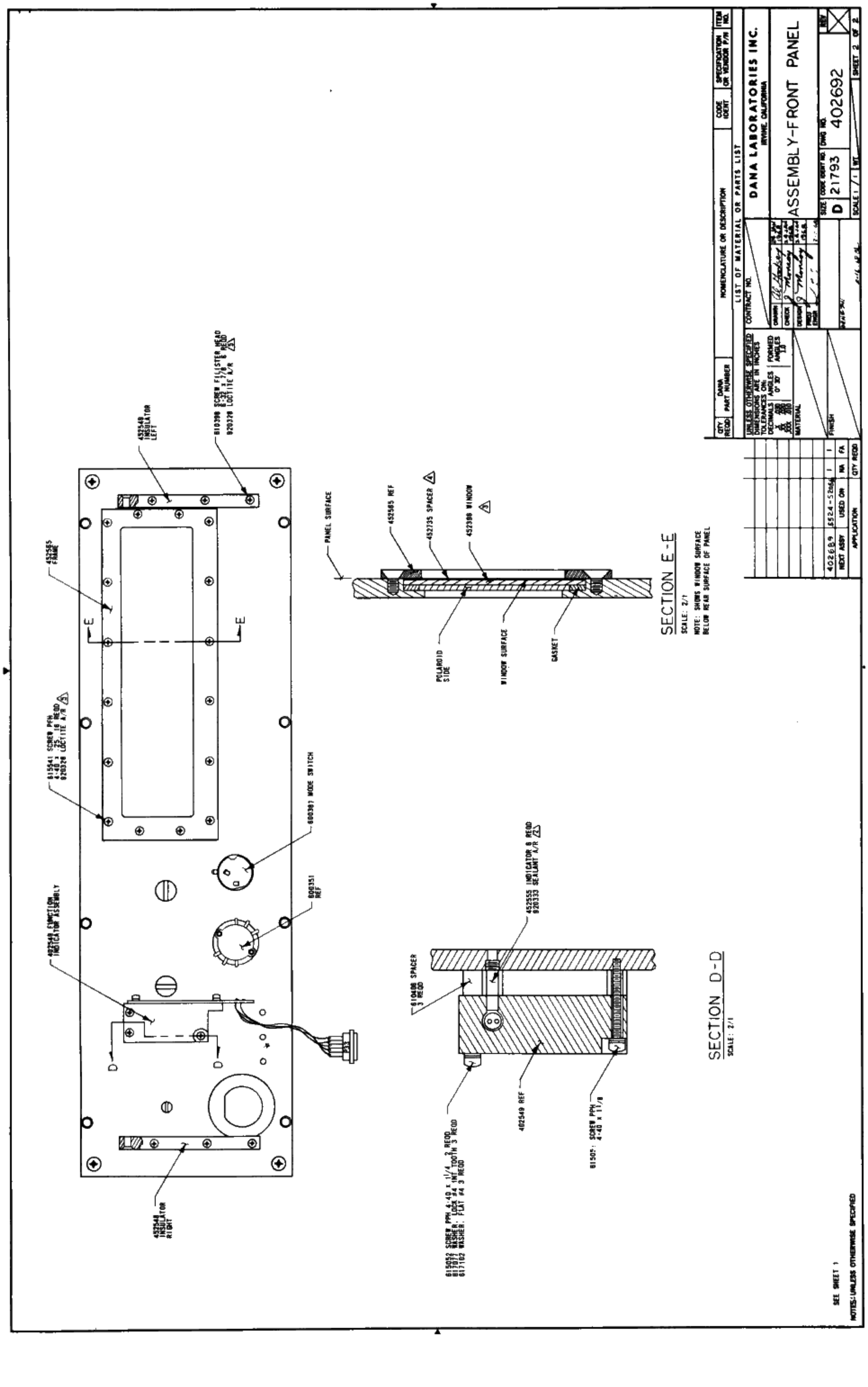
DRAWN / CHECK / DESIGN / PROJ ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

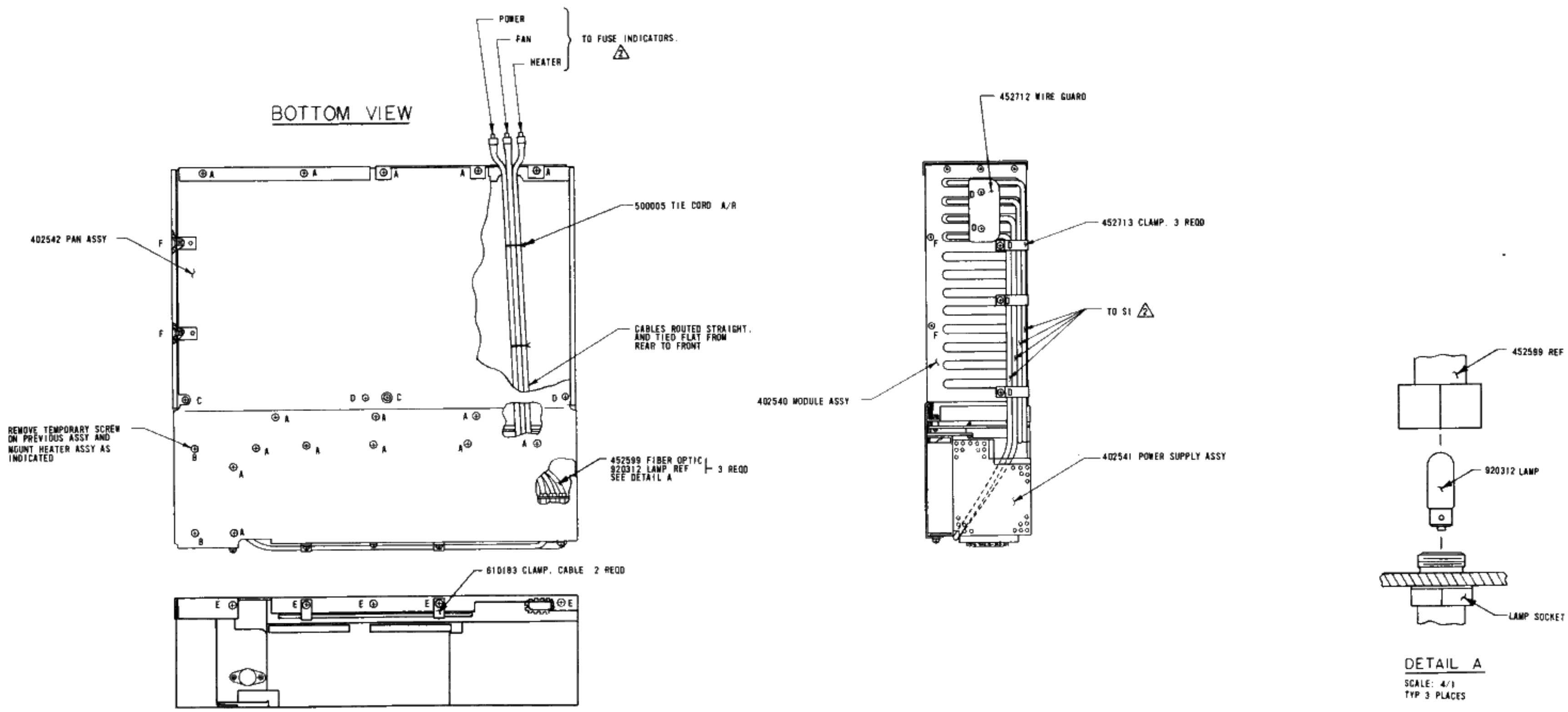
ASSEMBLY-FRONT PANEL

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	402692	A

SCALE 1/1 WT SHEET 1 OF 2



DANA LABORATORIES INC.
IRVINE, CALIFORNIA
ASSEMBLY-FRONT PANEL
D 21793 402692
SHEET 2 OF 2
SCALE 1/1
LIST OF MATERIAL OR PARTS LIST
402689 6524-5266 1 1
NEXT ASSY USED ON NA FA
APPLICATION QTY REQD
SECTION E-E
SCALE: 2/1
NOTE: SHOWS WINDOW SURFACE BELOW REAR SURFACE OF PANEL
SECTION D-D
SCALE: 2/1
452548 INSULATOR LEFT
452548 INSULATOR RIGHT
452565 FRAME
600387 MODE SWITCH
600351 REF
402549 FUNCTION INDICATOR ASSEMBLY
PANEL SURFACE
452565 REF
452735 SPACER
452388 WINDOW
POLAROID SIDE
WINDOW SURFACE
GASKET
452555 INDICATOR 8 REQD
920333 SEALANT A/R
610406 SPACER 3 REQD
402549 REF
SEE SHEET 1
NOTES: UNLESS OTHERWISE SPECIFIED



CODE	PART NO.	3 HARDWARE DESCRIPTION	QTY
A	615555	SCREW PFH 6-32 x 3/16 LG	15
B	615558	" PFH 6-32 x 3/8 LG	2
C	615042	" PPH 4-40 x 1/4 LG	2
	617077	WASHER, LOCK #4 INT TOOTH	2
D	615541	SCREW PFH 4-40 x 1/4 LG	7
E	615057	" PPH 6-32 x 1/4 LG	5
	617079	WASHER LOCK #6 INT TOOTH	5
F	615544	SCREW PFH 4-40 x 7/16	4

4. ROUTE JACKETED CABLES THRU CABLE CLAMPS
3. LOCTITE, DANA P/N 920328 TO BE APPLIED TO ALL HARDWARE WITHOUT LOCK WASHERS PER APPLICATION SPECIFICATION 900075
2. SEE NEXT ASSEMBLY FOR CABLE TERMINATIONS
1. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS

NOTES: UNLESS OTHERWISE SPECIFIED

NEXT ASSY	USED ON	NA	FA
402698	5524-STD	1	1
402689	5524-S2056	1	1

APPLICATION — QTY REQD

QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON: DECIMALS .X .030 .XX .020 .XXX .010; ANGLES 0° 30'; FORMED ANGLES 1.0

MATERIAL

FINISH

CONTRACT NO.

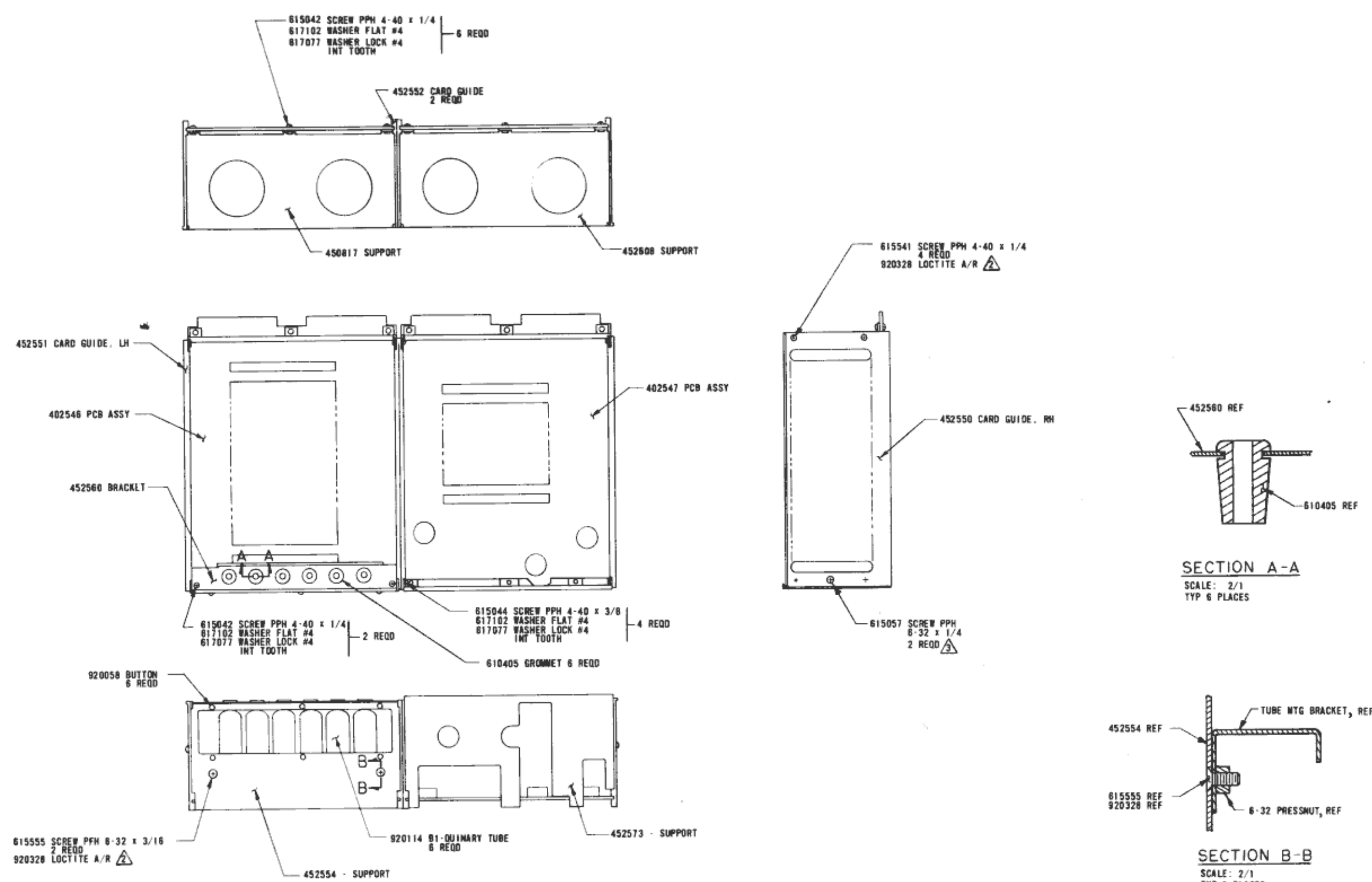
DRAWN Al Hodary 1968
CHECK J. Moray 1968
DESIGN J. Moray 1968
PROJ ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

CHASSIS ASSY-
DRAWER

SIZE D | CODE IDENT NO. 21793 | DWG NO. 402690 | REV

SCALE 1/2 | WT | SHEET 1 OF 1



QTY REQD	DANA PART NUMBER	NOMENCLATURE OR DESCRIPTION	CODE IDENT	SPECIFICATION OR VENDOR P/N	ITEM NO.

LIST OF MATERIAL OR PARTS LIST

NEXT ASSY	USED ON	NA	FA
402690	5524-STD	1	1
402690	5524-S8056	1	1
402536	5524	1	1

APPLICATION — QTY REQD

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON: DECIMALS .X .030, .XX .020, .XXX .010 — ANGLES 0° 30' — FORMED ANGLES 1.0
MATERIAL
FINISH

CONTRACT NO.
DRAWN W. Wright 8-7-67
CHECK J. Morley 30 JAN 1968
DESIGN J. Morley 15 JAN 1968
PROJ ENGR

DANA LABORATORIES INC.
IRVINE, CALIFORNIA

ASS'Y - MODULE

SIZE	CODE IDENT NO.	DWG NO.	REV
D	21793	402540	A

SCALE 1/2 — WT — SHEET 1 OF 1

NOTES: UNLESS OTHERWISE SPECIFIED
1. ASSEMBLY PROCEDURES AND PROCESSES TO CONFORM TO DANA WORKMANSHIP STANDARDS
2. APPLY LOCTITE PER APPLICATION SPECIFICATION 900075
3. SCREW TO BE REMOVED ON NEXT ASSEMBLY

PARTS LIST

ASSEMBLY 402538

REF. DESIG.	PART NO.	DESCRIPTION							
C10	120007	CAP	MYLAR	.22 MFD	600 V	20%		FLEC CUBE	210B1F224
C11	121146	CAP	MYLAR	.0047 MFD	100 V	10%1		CDE	WMF1D47
K1	310029	RELAY						AM ZETTLR	AZ420-56
K2	310029	RELAY						AM ZETTLR	AZ420-56
K3	310029	RELAY						AM ZETTLR	AZ420-56
K4	310030	RELAY	DC	4 PDT	28V		1	PARELCO	INR10-E046
K5	310029	RELAY						AM ZETTLR	AZ420-56
K7	310029	RELAY						AM ZETTLR	AZ420-56
K8	310011	RELAY	DC	2 PDT	26V			BABCOCK	BR16-125082
R25	010344	RES	METAL	237 K		1%	1/4 W	ELECTRA	RN60D2373F
R26	010164	RES	METAL	887 K		1%	1 W	ELECTRA	RN70D8873F
R53	040111	RES	VARI	200 K			1 W	BECKMAN	555R-200K
R54	000104	RES	CARBON	100 K		5%	1/4 W1	OHMITE	RC07GF104J

PARTS LIST

ASSEMBLY 402031

REF. DESIG.	PART NO.	DESCRIPTION							
C12	120089	CAP	MYLAR	4.7 MFD	60 V	10%		IONETICS	1047-60
C13	120089	CAP	MYLAR	4.7 MFD	60 V	10%		IONETICS	1047-60
R27	010020	RES	METAL	4.99 K		1%	1/4 W	ELECTRA	RN60D4991F
R28	020124	RES	WW	MATCHED SET				DANA	020124
R29	010165	RES	METAL	806 K		1%	1/2 W1	ELECTRA	RN65D8063F
R30	020124	RES	WW	MATCHED SET				DANA	020124
R31	020241	RES	WW	10 K		.05%	1/8 W	JORDAN	J-11
R32	020241	RES	WW	10 K		.05%	1/8 W	JORDAN	J-11
R33	010020	RES	METAL	4.99 K		1%	1/4 W	ELECTRA	RN60D4991F
R34	040033	RES	VARI	1 K		10%	1 W	TECHNO	20
R35	020124	RES	WW	MATCHED SET				DANA	020124
R36	040033	RES	VARI	1 K		10%	1 W	TECHNO	20
R37	000823	RES	CARBON	82 K		5%	1/4 W1	OHMITE	RC07GF823J
R38	000154	RES	CARBON	150 K		5%	1/4 W1	OHMITE	RC07GF154J
R39	000824	RES	CARBON	820 K		5%	1/4 W	OHMITE	RC07GF824J
R40	000153	RES	CARBON	15 K		5%	1/4 W1	OHMITE	RC07GF153J
R41	010161	RES	METAL	110 OHM		1%	1/4 W	ELECTRA	RN60D1100F
R42	020204	RES	WW	1.1111 K		.05%	1/8 W	JORDAN	J-11
R43	020170	RES	WW	100.83 OHM		.05%	1/8 W	KELVIN	EP-20
R44	040053	RES	VARI	5 K		10%	1.5 W	CTS	110
R45	040053	RES	VARI	5 K		10%	1.5 W	CTS	110

PARTS LIST

ASSEMBLY 402477

REF. DESIG.	PART NO.	DESCRIPTION						
CR01	200048	TRANS SILICO NPN DUAL 2N3565					DANA	200048
CR2	211236	DIODE SILICO	007				DANA	211236
CR03	200048	TRANS SILICO NPN DUAL 2N3565					DANA	200048
CR4	211236	DIODE SILICO	007				DANA	211236
CR5	211083	DIODE SILICO	018			1	DANA	211083
CR6	211083	DIODE SILICO	018			1	DANA	211083
CR7	211083	DIODE SILICO	018			1	DANA	211083
CR8	211083	DIODE SILICO	018			1	DANA	211083
CR9	220012	DIODE SILICO ZENER 1N958B				1	MOTOROLA	1N958B
CR10	220012	DIODE SILICO ZENER 1N958B				1	MOTOROLA	1N958B
CR11	211083	DIODE SILICO	018			1	DANA	211083
CR12	211083	DIODE SILICO	018			1	DANA	211083
CR13	211083	DIODE SILICO	018			1	DANA	211083
CR14	211083	DIODE SILICO	018			1	DANA	211083
CR15	211083	DIODE SILICO	018			1	DANA	211083
CR16	210004	DIODE SILICO	SD4				DIODES IN SD4	
CR17	210004	DIODE SILICO	SD4				DIODES IN SD4	
CR18	221177	DIODE SILICO ZENER				1/4 W1	MOTOROLA	M.2.4A25
CR19	200048	TRANS SILICO NPN DUAL 2N3565					DANA	200048
CR20	200048	TRANS SILICO NPN DUAL 2N3565					DANA	200048
C01	120128	CAP POLYS	.0056 MFD	125V		5%	OIEL	N100
C02	120092	CAP MYLAR	1 MFD	300V			IMB	ZA20105K
C3	120063	CAP MYLAR	2 MFD	100 V		5%1	IMB	XT2B205J
C4	121146	CAP MYLAR	.0047 MFD	100 V		10%1	CDE	WMF1D47
C5	120005	CAP MYLAR	.001 MFD	100 V		10%1		WMF1D1
C6	110038	CAP ELECT	50 MFD	15 V		20%	DUCATI	50-15
C7	110038	CAP ELECT	50 MFD	15 V		20%	DUCATI	50-15
C8	110039	CAP ELECT	5 MFD	50 V		20%	DUCATI	5-50
C9	120003	CAP MYLAR	.1 MFD	100 V		10%1	CDE	WMF1P1
C10	110036	CAP ELECT	25 MFD	50 V		20%	DUCATI	25-50
C11	110036	CAP ELECT	25 MFD	50 V		20%	DUCATI	25-50
C12	100013	CAP CERAM	15 PFD	500 V		10%	AEROVOX	TCD-N750
C13	101145	CAP CERAM	100 PFD	500 V		10%1	AEROVOX	SCD1X5F
C14	120003	CAP MYLAR	.1 MFD	100 V		10%1	CDE	WMF1P1
C15	101145	CAP CERAM	100 PFD	500 V		10%1	AEROVOX	SCD1X5F
Q1	201084	TRANS GERMAN PNP		2N1304		1	TI	2N1304
Q2	200027	TRANS SILICO		FSV			DANA	200027
Q3	200044	TRANS SILICO NPN DUAL		FSV			DANA	200044

PARTS LIST

ASSEMBLY 402477

REF. DESIG.	PART NO.	DESCRIPTION							
Q4	200044	TRANS	SILICO	NPN DUAL	FSV			DANA	200044
Q5	200036	TRANS	SILICO	NPN	015			DANA	200036
Q6	200036	TRANS	SILICO	NPN	015			DANA	200036
Q7	200043	TRANS	SILICO	NPN	2N3565			FAIRCHILD	2N3565
Q8	200043	TRANS	SILICO	NPN	2N3565			FAIRCHILD	2N3565
Q9	200035	TRANS	SILICO	NPN	014			DANA	200035
Q10	200022	TRANS	SILICO	PNP	012			DANA	200022
Q11	200052	TRANS	SILICO	PNP	009			DANA	200052
Q12	200043	TRANS	SILICO	NPN	2N3565			FAIRCHILD	2N3565
Q13	200043	TRANS	SILICO	NPN	2N3565			FAIRCHILD	2N3565
Q14	200022	TRANS	SILICO	PNP	012			DANA	200022
Q15	200035	TRANS	SILICO	NPN	014			DANA	200035
Q16	200035	TRANS	SILICO	NPN	014			DANA	200035
R1	000152	RES	CARBON	1.5 K	5%	1/4 W1		OHMITE	RC07GF152J
R2	000101	RES	CARBON	100 OHM	5%	1/4 W1		OHMITE	RC07GF101J
R3	010249	RES	WW	25 M	2%	1/8 W		DALE	DC-2
R4	000101	RES	CARBON	100 OHM	5%	1/4 W1		OHMITE	RC07GF101J
R5	000622	RES	CARBON	6.2 K	5%	1/4 W1		OHMITE	RC07GF622J
R6	000242	RES	CARBON	2.4 K	5%	1/4 W1		OHMITE	RC07GF242J
R7	040005	RES	VARI	10 K	10%	1/2 W		BOURNS	3067-P-1-10
R8	000152	RES	CARBON	1.5 K	5%	1/4 W1		OHMITE	RC07GF152J
R10	000752	RES	CARBON	7.5 K	5%	1/4 W1		OHMITE	RC07GF752J
R11	000136	RES	CARBON	13 M	5%	1/4 W		OHMITE	RC07GF136J
R12	001734	RES	FSV					DANA	001734
R13	010236	RES	WW	10 MEG	1%	1 W1		PME	PME70T2
R15	000685	RES	CARBON	6.8 M	5%	1/4 W		OHMITE	RC07GF685J
R16	000132	RES	CARBON	1.3 K	5%	1/4 W		OHMITE	RC07GF132J
R18	010236	RES	WW	10 MEG	1%	1 W1		PME	PME70T2
R20	000335	RES	CARBON	3.3 M	5%	1/4 W1		OHMITE	RC07GF335J
R21	000565	RES	CARBON	5.6 M	5%	1/4 W1		OHMITE	RC07GF565J
R22	000393	RES	CARBON	39 K	5%	1/4 W		OHMITE	RC07GF393J
R23	000912	RES	CARBON	9.1 K	5%	1/4 W1		OHMITE	RC07GF912J
R24	000513	RES	CARBON	51 K	5%	1/4 W1		OHMITE	RC07GF513J
R25	000102	RES	CARBON	1 K	5%	1/4 W1		OHMITE	RC07GF102J
R26	000122	RES	CARBON	1.2 K	5%	1/4 W1		OHMITE	RC07GF122J
R27	000102	RES	CARBON	1 K	5%	1/4 W1		OHMITE	RC07GF102J
R28	000472	RES	CARBON	4.7 K	5%	1/4 W1		OHMITE	RC07GF472J
R29	000101	RES	CARBON	100 OHM	5%	1/4 W1		OHMITE	RC07GF101J

PARTS LIST

ASSEMBLY 402477

REF. DESIG.	PART NO.	DESCRIPTION							
R30	000912	RES	CARBON	9.1 K	5%	1/4 W1		OHMITE	RC07GF912J
R31	000102	RES	CARBON	1 K	5%	1/4 W1		OHMITE	RC07GF102J
R32	000912	RES	CARBON	9.1 K	5%	1/4 W1		OHMITE	RC07GF912J
R33	000332	RES	CARBON	3.3 K	5%	1/4 W1		OHMITE	RC07GF332J
R34	000332	RES	CARBON	3.3 K	5%	1/4 W1		OHMITE	RC07GF332J
R35	000511	RES	CARBON	510 OHM	5%	1/4 W1		OHMITE	RC07GF511J
R36	000153	RES	CARBON	15 K	5%	1/4 W1		OHMITE	RC07GF153J
R37	000240	RES	CARBON	24 OHM	5%	1/4 W1		OHMITE	RC07GF240J
R38	000750	RES	CARBON	75 OHM	5%	1/4 W1		OHMITE	RC07GF750J
R39	000240	RES	CARBON	24 OHM	5%	1/4 W1		OHMITE	RC07GF240J
R40	000433	RES	CARBON	43 K	5%	1/4 W		OHMITE	RC07GF433J
R41	000101	RES	CARBON	100 OHM	5%	1/4 W1		OHMITE	RC07GF101J
R42	000153	RES	CARBON	15 K	5%	1/4 W1		OHMITE	RC07GF153J
R43	000103	RES	CARBON	10 K	5%	1/4 W1		OHMITE	RC07GF103J
R44	001734	RES	FSV					DANA	001734
R49	000750	RES	CARBON	75 OHM	5%	1/4 W1		OHMITE	RC07GF750J

PARTS LIST

ASSEMBLY 402038

REF. DESIG.	PART NO.	DESCRIPTION						
CR1	211083	DIODE SILICO	018			1	DANA	211083
A-CR1	210004	DIODE SILICO	SD4				DIODES IN SD4	
CR2	211083	DIODE SILICO	018			1	DANA	211083
A-CR2	210004	DIODE SILICO	SD4				DIODES IN SD4	
J-CR02	210004	DIODE SILICO	SD4				DIODES IN SD4	
K-CR2	210004	DIODE SILICO	SD4				DIODES IN SD4	
M-CR2	210004	DIODE SILICO	SD4				DIODES IN SD4	
CR3	211083	DIODE SILICO	018			1	DANA	211083
A-CR3	210004	DIODE SILICO	SD4				DIODES IN SD4	
L-CR3	210004	DIODE SILICO	SD4				DIODES IN SD4	
U-CR3	210004	DIODE SILICO	SD4				DIODES IN SD4	
CR4	211083	DIODE SILICO	018			1	DANA	211083
A-CR4	210004	DIODE SILICO	SD4				DIODES IN SD4	
CR5	210004	DIODE SILICO	SD4				DIODES IN SD4	
CR25	211083	DIODE SILICO	018			1	DANA	211083
CR26	211083	DIODE SILICO	018			1	DANA	211083
CR27	211083	DIODE SILICO	018			1	DANA	211083
CR28	211083	DIODE SILICO	018			1	DANA	211083
CR36	211083	DIODE SILICO	018			1	DANA	211083
CR37	210004	DIODE SILICO	SD4				DIODES IN SD4	
CR38	210004	DIODE SILICO	SD4				DIODES IN SD4	
CR39	211083	DIODE SILICO	018			1	DANA	211083
CR42	211083	DIODE SILICO	018			1	DANA	211083
C01	101174	CAP CERAM	.001 MFD 500 V			10%1	AEROVOX	SCD3X5F
E-C01	121092	CAP MYLAR	.0022 MFD 100 V			10%	CDE	WMF1D22
Q01	200043	TRANS SILICO NPN	2N3565				FAIRCHILD	2N3565
B-Q01	200037	TRANS SILICO NPN	2N3646				FAIRCHILD	2N3646
Q02	200043	TRANS SILICO NPN	2N3565				FAIRCHILD	2N3565
B-Q02	200043	TRANS SILICO NPN	2N3565				FAIRCHILD	2N3565
Q03	200043	TRANS SILICO NPN	2N3565				FAIRCHILD	2N3565
Q04	200035	TRANS SILICO NPN	014				DANA	200035
Q05	200043	TRANS SILICO NPN	2N3565				FAIRCHILD	2N3565
Q06	200043	TRANS SILICO NPN	2N3565				FAIRCHILD	2N3565
R01	000222	RES CARBON	2.2 K	5%	1/4 W1		OHMITE	RC07GF222J
R02	000153	RES CARBON	15 K	5%	1/4 W1		OHMITE	RC07GF153J
R03	000222	RES CARBON	2.2 K	5%	1/4 W1		OHMITE	RC07GF222J
R04	000153	RES CARBON	15 K	5%	1/4 W1		OHMITE	RC07GF153J
R05	000822	RES CARBON	8.2 K	5%	1/4 W1		OHMITE	RC07GF822J

PARTS LIST

ASSEMBLY 402038

REF. DESIG.	PART NO.	DESCRIPTION						
CR1	211083	DIODE	SILICO	018		1	DANA	211083
A-CR1	210004	DIODE	SILICO	SD4			DIODES IN SD4	
CR2	211083	DIODE	SILICO	018		1	DANA	211083
A-CR2	210004	DIODE	SILICO	SD4			DIODES IN SD4	
J-CR02	210004	DIODE	SILICO	SD4			DIODES IN SD4	
K-CR2	210004	DIODE	SILICO	SD4			DIODES IN SD4	
M-CR2	210004	DIODE	SILICO	SD4			DIODES IN SD4	
CR3	211083	DIODE	SILICO	018		1	DANA	211083
A-CR3	210004	DIODE	SILICO	SD4			DIODES IN SD4	
L-CR3	210004	DIODE	SILICO	SD4			DIODES IN SD4	
U-CR3	210004	DIODE	SILICO	SD4			DIODES IN SD4	
CR4	211083	DIODE	SILICO	018		1	DANA	211083
A-CR4	210004	DIODE	SILICO	SD4			DIODES IN SD4	
CR5	210004	DIODE	SILICO	SD4			DIODES IN SD4	
CR25	211083	DIODE	SILICO	018		1	DANA	211083
CR26	211083	DIODE	SILICO	018		1	DANA	211083
CR27	211083	DIODE	SILICO	018		1	DANA	211083
CR28	211083	DIODE	SILICO	018		1	DANA	211083
CR36	211083	DIODE	SILICO	018		1	DANA	211083
CR37	210004	DIODE	SILICO	SD4			DIODES IN SD4	
CR38	210004	DIODE	SILICO	SD4			DIODES IN SD4	
CR39	211083	DIODE	SILICO	018		1	DANA	211083
CR42	211083	DIODE	SILICO	018		1	DANA	211083
C01	101174	CAP	CERAM	.001 MFD 500 V		10%1	AEROVOX	SCD3X5F
E-C01	121092	CAP	MYLAR	.0022 MFD 100 V		10%	CDE	WMF1D22
Q01	200043	TRANS	SILICO NPN	2N3565			FAIRCHILD	2N3565
B-Q01	200037	TRANS	SILICO NPN	2N3646			FAIRCHILD	2N3646
Q02	200043	TRANS	SILICO NPN	2N3565			FAIRCHILD	2N3565
B-Q02	200043	TRANS	SILICO NPN	2N3565			FAIRCHILD	2N3565
Q03	200043	TRANS	SILICO NPN	2N3565			FAIRCHILD	2N3565
Q04	200035	TRANS	SILICO NPN	014			DANA	200035
Q05	200043	TRANS	SILICO NPN	2N3565			FAIRCHILD	2N3565
Q06	200043	TRANS	SILICO NPN	2N3565			FAIRCHILD	2N3565
R01	000222	RES	CARBON	2.2 K	5%	1/4 W1	OHMITE	RC07GF222J
R02	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R03	000222	RES	CARBON	2.2 K	5%	1/4 W1	OHMITE	RC07GF222J
R04	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R05	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J

PARTS LIST

ASSEMBLY 40203B

REF. DESIG.	PART NO.	DESCRIPTION							
R06	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R07	000204	RES	CARBON	200 K	5%	1/4 W	OHMITE	RC07GF204J
R08	000243	RES	CARBON	24 K	5%	1/4 W1	OHMITE	RC07GF243J
B-R08	000123	RES	CARBON	12 K	5%	1/4 W1	OHMITE	RC07GF123J
C-R08	000123	RES	CARBON	12 K	5%	1/4 W1	OHMITE	RC07GF123J
D-R08	000512	RES	CARBON	5.1 K	5%	1/4 W1	OHMITE	RC07GF512J
E-R08	000512	RES	CARBON	5.1 K	5%	1/4 W1	OHMITE	RC07GF512J
H-R08	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
J-R08	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
K-R08	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
L-R08	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
M-R08	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
R10	000273	RES	CARBON	27 K	5%	1/4 W1	OHMITE	RC07GF273J
R11	000243	RES	CARBON	24 K	5%	1/4 W1	OHMITE	RC07GF243J
R12	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
R13	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
R14	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R15	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
R18	030012	RES	CARBON	130 K	5%	1 W	OHMITE	RC32GF134J
R19	000512	RES	CARBON	5.1 K	5%	1/4 W1	OHMITE	RC07GF512J
R20	000104	RES	CARBON	100 K	5%	1/4 W1	OHMITE	RC07GF104J
R21	000512	RES	CARBON	5.1 K	5%	1/4 W1	OHMITE	RC07GF512J
R22	000512	RES	CARBON	5.1 K	5%	1/4 W1	OHMITE	RC07GF512J
R23	030012	RES	CARBON	130 K	5%	1 W	OHMITE	RC32GF134J

PARTS LIST

ASSEMBLY 402102

REF. DESIG.	PART NO.	DESCRIPTION						
CR1	211083	DIODE SILICO	018		1	DANA	211083
CR2	211083	DIODE SILICO	018		1	DANA	211083
CR3	211083	DIODE SILICO	018		1	DANA	211083
CR4	211083	DIODE SILICO	018		1	DANA	211083
CR5	211083	DIODE SILICO	018		1	DANA	211083
CR6	211083	DIODE SILICO	018		1	DANA	211083
CR7	211083	DIODE SILICO	018		1	DANA	211083
CR8	211083	DIODE SILICO	018		1	DANA	211083
CR9	220004	DIODE SILICO ZENER	1N961B		1	MOTOROLA	1N961B
CR10	211083	DIODE SILICO	018		1	DANA	211083
CR11	211083	DIODE SILICO	018		1	DANA	211083
CR12	210004	DIODE SILICO	SD4			DIODES IN SD4	
CR13	210004	DIODE SILICO	SD4			DIODES IN SD4	
CR14	210004	DIODE SILICO	SD4			DIODES IN SD4	
CR15	211083	DIODE SILICO	018		1	DANA	211083
C1	130043	CAP GLASS	7.5 PFD 500 V	10%		CORN	CYFM10C7R7
C2	130029	CAP GLASS	1-5 PFD 500 V	10%		LRC	682116
C3	110017	CAP TANTA	1 MFD 35 V	10%1		KEMET	K1C35K
C4	110038	CAP ELECT	50 MFD 15 V	20%		DUCATI	50-15
C5	110001	CAP TANTA	6.8 MFD 35 V	10%1		KEMET	K6R8C35K
C6	101641	CAP CERAM	470 PFD 500 V	10%1		AEROVOX	SCD1X5F
C7	130039	CAP GLASS	27 PFD 500 V	10%		CORN	CYFM10C270J
C8	130029	CAP GLASS	1-5 PFD 500 V	10%		LRC	682116
C9	100006	CAP CERAM	10 PFD 500 V	10%1		AEROVOX	TCD-N750
C10	130034	CAP CERAM	7-45 PFD 500 V	10%		CRL	822BN-N650
C11	130040	CAP GLASS	240 PFD 300 V	10%		CORN	CYFM10C241J
C13	130041	CAP GLASS	3000 PFD 500 V	10%		CORN	CYFM200302J
C14	100006	CAP CERAM	10 PFD 500 V	10%1		AEROVOX	TCD-N750
C15	101641	CAP CERAM	470 PFD 500 V	10%1		AEROVOX	SCD1X5F
C16	110001	CAP TANTA	6.8 MFD 35 V	10%1		KEMET	K6R8C35K
C17	100005	CAP CERAM	22 PFD 500 V	10%		AEROVOX	TCD-N750
C18	110001	CAP TANTA	6.8 MFD 35 V	10%1		KEMET	K6R8C35K
C19	110002	CAP TANTA	22 MFD 35 V	10%1		KEMET	K22C35K
C20	110001	CAP TANTA	6.8 MFD 35 V	10%1		KEMET	K6R8C35K
C21	120069	CAP MYLAR	.39 MFD 100 V	10%		IMB	XA1134K
C22	130034	CAP CERAM	7-45 PFD 500 V	10%		CRL	822BN-N650
C23	130027	CAP GLASS	10 PFD 500 V	10%		CORN	CYFM-10C100
K1	310013	RELAY REED	SPST 24V		1	WHEELOCK	2961A X6

PARTS LIST

ASSEMBLY 402102

REF. DESIG.	PART NO.	DESCRIPTION								
K2	310013	RELAY	REED		SPST	24V		1	WHEELOCK	2961A X6
K3	310022	RELAY	DC		4 PDT	29V			ALLIED	TS154-OC-CC
Q1	200035	TRANS	SILICO NPN		014				DANA	200035
Q2	200035	TRANS	SILICO NPN		014				DANA	200035
Q3	200035	TRANS	SILICO NPN		014				DANA	200035
Q4	200043	TRANS	SILICO NPN		2N3565				FAIRCHILD	2N3565
Q5	200043	TRANS	SILICO NPN		2N3565				FAIRCHILD	2N3565
Q6	200043	TRANS	SILICO NPN		2N3565				FAIRCHILD	2N3565
Q7	200043	TRANS	SILICO NPN		2N3565				FAIRCHILD	2N3565
Q8	200043	TRANS	SILICO NPN		2N3565				FAIRCHILD	2N3565
Q9	200011	TRANS	SILICO PNP		009				DANA	200011
Q10	200035	TRANS	SILICO NPN		014				DANA	200035
R1	000473	RES	CARBON	47	K	5%	1/4	W1	OHMITE	RC07GF473J
R2	010280	RES	WW	329	K	.25%	1/8	W	PME	PME329KT2
R3	000473	RES	CARBON	47	K	5%	1/4	W1	OHMITE	RC07GF473J
R4	000684	RES	CARBON	680	K	5%	1/4	W	OHMITE	RC07GF684J
R5	000101	RES	CARBON	100	OHM	5%	1/4	W1	OHMITE	RC07GF101J
R6	000913	RES	CARBON	91	K	5%	1/4	W	OHMITE	RC07GF913J
R7	000470	RES	CARBON	47	OHM	5%	1/4	W1	OHMITE	RC07GF470J
R8	000682	RES	CARBON	6.8	K	5%	1/4	W1	OHMITE	RC07GF682J
R9	000272	RES	CARBON	2.7	K	5%	1/4	W	OHMITE	RC07GF272J
R10	000201	RES	CARBON	200	OHM	5%	1/4	W1	OHMITE	RC07GF201J
R11	010280	RES	WW	329	K	.25%	1/8	W	PME	PME329KT2
R12	000913	RES	CARBON	91	K	5%	1/4	W	OHMITE	RC07GF913J
R13	010280	RES	WW	329	K	.25%	1/8	W	PME	PME329KT2
R14	010280	RES	WW	329	K	.25%	1/8	W	PME	PME329KT2
R15	000152	RES	CARBON	1.5	K	5%	1/4	W1	OHMITE	RC07GF152J
R16	000201	RES	CARBON	200	OHM	5%	1/4	W1	OHMITE	RC07GF201J
R17	000392	RES	CARBON	0003.9	K	5%	1/4	W1	OHMITE	RC07GF392J
R18	040053	RES	VARI	5	K	10%	1.5	W	CTS	110
R19	040062	RES	VARI	500	OHM	10%	1.5	W	CTS	110
R20	040052	RES	VARI	50	OHM	10%	1.5	W	CTS	110
R21	000153	RES	CARBON	15	K	5%	1/4	W1	OHMITE	RC07GF153J
R22	000330	RES	CARBON	33	K	5%	1/4	W	OHMITE	RC07GF330J
R23	000751	RES	CARBON	750	OHM	5%	1/4	W1	OHMITE	RC07GF751J
R24	000330	RES	CARBON	33	K	5%	1/4	W	OHMITE	RC07GF330J
R25	000432	RES	CARBON	4.3	K	5%	1/4	W1	OHMITE	RC07GF432J
R26	000103	RES	CARBON	10	K	5%	1/4	W1	OHMITE	RC07GF103J

PARTS LIST

ASSEMBLY 402102

REF. DESIG.	PART NO.	DESCRIPTION							
R27	000910	RES	CARBON	91 OHM	5%	1/4 W1	OHMITE	RC07GF910J
R28	000390	RES	CARBON	39 OHM	5%	1/4 W1	OHMITE	RC07GF390J
R29	020165	RES	WW	270 K	1%	1/8 W	KELVIN	EP-20
R30	020165	RES	WW	270 K	1%	1/8 W	KELVIN	EP-20
R31	020164	RES	WW	135 K	.1%	1/8 W	KELVIN	EP-20
R32	020164	RES	WW	135 K	.1%	1/8 W	KELVIN	EP-20
R33	000202	RES	CARBON	2 K	5%	1/4 W1	OHMITE	RC07GF202J
R34	001705	RES	CARBON	820 OHM	5%	1/2 W	OHMITE	RC20GF821J
R35	000152	RES	CARBON	1.5 K	5%	1/4 W1	OHMITE	RC07GF152J

PARTS LIST

ASSEMBLY 402036

REF. DESIG.	PART NO.	DESCRIPTION							
CR1	220012	DIODE	SILICO ZENER	1N958B			1	MOTOROLA	1N958B
CR10	211083	DIODE	SILICO	018			1	DANA	211083
CR11	211083	DIODE	SILICO	018			1	DANA	211083
CR12	211083	DIODE	SILICO	018			1	DANA	211083
CR13	211083	DIODE	SILICO	018			1	DANA	211083
CR14	211083	DIODE	SILICO	018			1	DANA	211083
CR15	211083	DIODE	SILICO	018			1	DANA	211083
CR16	211083	DIODE	SILICO	018			1	DANA	211083
CR17	211083	DIODE	SILICO	018			1	DANA	211083
CR18	211083	DIODE	SILICO	018			1	DANA	211083
CR19	211083	DIODE	SILICO	018			1	DANA	211083
CR2	220012	DIODE	SILICO ZENER	1N958B			1	MOTOROLA	1N958B
CR3	210006	DIODE	SILICO	S368				G.E.	S368
CR4	210006	DIODE	SILICO	S368				G.E.	S368
CR5	221177	DIODE	SILICO ZENER				1/4 W1	MOTOROLA	M.2.4A25
CR6	220007	DIODE	SILICO ZENER	1N751			1	MOTOROLA	1N751
CR7	210007	DIODE	SILICO	166				G.E.	DH0166
CR8	210007	DIODE	SILICO	166				G.E.	DH0166
CR9	211083	DIODE	SILICO	018			1	DANA	211083
C01	110039	CAP	ELECT	5 MFD	50 V	20%		DUCATI	5-50
C02	110039	CAP	ELECT	5 MFD	50 V	20%		DUCATI	5-50
C03	120039	CAP	POLYS	24 PFD	500 V	5%		CRL	CPR-24J
C04	120039	CAP	POLYS	24 PFD	500 V	5%		CRL	CPR-24J
C05	101145	CAP	CERAM	100 PFD	500 V	10%1		AEROVOX	SCD1X5F
C06	100012	CAP	CERAM	33 PFD	500 V	10%		AEROVOX	TCD-N750
C07	101175	CAP	CERAM	220 PFD	500 V	10%1		AEROVOX	SCD1X5F
C08	101099	CAP	CERAM	680 PFD	500 V	10%1		AEROVOX	SCD2X5F
C11	100010	CAP	CERAM	68 PFD	500 V	10%		AERVOX	TCD-N750
C12	100010	CAP	CERAM	68 PFD	500 V	10%		AERVOX	TCD-N750
C13	110044	CAP	ELECT	50 MFD	50 V	20%		DUCATI	50-50
C14	120005	CAP	MYLAR	.001 MFD	100 V	10%1			WMF1D1
C15	120005	CAP	MYLAR	.001 MFD	100 V	10%1			WMF1D1
C16	100010	CAP	CERAM	68 PFD	500 V	10%		AERVOX	TCD-N750
C17	100010	CAP	CERAM	68 PFD	500 V	10%		AERVOX	TCD-N750
C18	121393	CAP	MYLAR	.22 MFD	100 V	10%		CDE	WMF1P22
K01	311274	RELAY	DC	2 PDT	26V			BABCOCK	BR12H-1.6KC
Q01	201084	TRANS	GERMAN PNP	2N1304			1	TI	2N1304
Q02	200036	TRANS	SILICO NPN	015				DANA	200036

PARTS LIST

ASSEMBLY 402036

REF. DESIG.	PART NO.	DESCRIPTION						
Q03	200040	TRANS	SILICO NPN	016			DANA	200040
Q04	200040	TRANS	SILICO NPN	016			DANA	200040
Q05	200043	TRANS	SILICO NPN	2N3565			FAIRCHILD	2N3565
Q06	200011	TRANS	SILICO PNP	009			DANA	200011
Q07	200035	TRANS	SILICO NPN	014			DANA	200035
Q08	200011	TRANS	SILICO PNP	009			DANA	200011
Q09	200035	TRANS	SILICO NPN	014			DANA	200035
Q10	200043	TRANS	SILICO NPN	2N3565			FAIRCHILD	2N3565
Q11	200043	TRANS	SILICO NPN	2N3565			FAIRCHILD	2N3565
Q12	200037	TRANS	SILICO NPN	2N3646			FAIRCHILD	2N3646
Q13	200037	TRANS	SILICO NPN	2N3646			FAIRCHILD	2N3646
Q14	200049	TRANS		2N3417			GE	2N3417
Q15	200035	TRANS	SILICO NPN	014			DANA	200035
Q16	200049	TRANS		2N3417			GE	2N3417
Q17	200043	TRANS	SILICO NPN	2N3565			FAIRCHILD	2N3565
R01	020166	RES	WW	10 K	.05%	1/8 W	JORDAN	LR-11
R02	020379							
R03	040050	RES	VARI	5 K	10%	1/2 W	BOURNS	3067-P-1-K0
R04	000203	RES	CARBON	20 K	5%	1/4 W1	OHMITE	RC07GF203J
R05	000101	RES	CARBON	100 OHM	5%	1/4 W1	OHMITE	RC07GF101J
R06	010079	RES	METAL	7.5 K	1%	1/4 W1	ELECTRA	RN60D7501F
R07	040004	RES	VARI	100 K	10%	1/5 W	BOURNS	3068-P-1-10
R08	020166	RES	WW	10 K	.05%	1/8 W	JORDAN	LR-11
R09	010167	RES	METAL	442 K	1%	1/4 W1	ELECTRA	RN60D4423F
R10	020166	RES	WW	10 K	.05%	1/8 W	JORDAN	LR-11
R11	040050	RES	VARI	5 K	10%	1/2 W	BOURNS	3067-P-1-K0
R12	001713	RES	FSV		5%	1/4 W	DANA	001713
R13	010158	RES	METAL	200 K	1%	1/4 W1	ELECTRA	RN60D2003F
R14	010282	RES	METAL	140 K	1%	1/4 W	IRC	RN60C1403F
R15	001713	RES	FSV		5%	1/4 W	DANA	001713
R16	010158	RES	METAL	200 K	1%	1/4 W1	ELECTRA	RN60D2003F
R17	000102	RES	CARBON	1 K	5%	1/4 W1	OHMITE	RC07GF102J
R18	010167	RES	METAL	442 K	1%	1/4 W1	ELECTRA	RN60D4423F
R19	010060	RES	METAL	10 K	1%	1/4 W	ELECTRA	RN60D1002F
R20	010039	RES	METAL	9.09 K	1%	1/4 W	ELECTRA	RN60D9091F
R21	000102	RES	CARBON	1 K	5%	1/4 W1	OHMITE	RC07GF102J
R22	010167	RES	METAL	442 K	1%	1/4 W1	ELECTRA	RN60D4423F
R23	000203	RES	CARBON	20 K	5%	1/4 W1	OHMITE	RC07GF203J

PARTS LIST

ASSEMBLY 402036

REF. DESIG.	PART NO.	DESCRIPTION						
R24	001712	RES	CARBON	750 OHM	5%	1/2 W	OHMITE	RC20GF751J
R25	000220	RES	CARBON	22 OHM	5%	1/4 W1	OHMITE	RC07GF220J
R26	000820	RES	CARBON	82 OHM	5%	1/4 W	OHMITE	RC07GF820J
R27	000101	RES	CARBON	100 OHM	5%	1/4 W1	OHMITE	RC07GF101J
R28	000220	RES	CARBON	22 OHM	5%	1/4 W1	OHMITE	RC07GF220J
R30	000220	RES	CARBON	22 OHM	5%	1/4 W1	OHMITE	RC07GF220J
R31	000101	RES	CARBON	100 OHM	5%	1/4 W1	OHMITE	RC07GF101J
R32	000222	RES	CARBON	2.2 K	5%	1/4 W1	OHMITE	RC07GF222J
R33	001674	RES	CARBON	680 OHM	5%	1/2 W1	OHMITE	RC20GF681J
R34	000103	RES	CARBON	10 K	5%	1/4 W1	OHMITE	RC07GF103J
R35	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R36	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R37	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R38	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R39	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
R40	000303	RES	CARBON	30 K	5%	1/4 W1	OHMITE	RC07GF303J
R41	000123	RES	CARBON	12 K	5%	1/4 W1	OHMITE	RC07GF123J
R42	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
R43	000303	RES	CARBON	30 K	5%	1/4 W1	OHMITE	RC07GF303J
R44	000123	RES	CARBON	12 K	5%	1/4 W1	OHMITE	RC07GF123J
R45	000163	RES	CARBON	16 K	5%	1/4 W1	OHMITE	RC07GF163J
R46	000102	RES	CARBON	1 K	5%	1/4 W1	OHMITE	RC07GF102J
R47	000105	RES	CARBON	1 M	5%	1/4 W1	OHMITE	RC07GF105J
R48	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
R49	040003	RES	VARI	20 K	10%	1/2 W	BOURNS	3067-P-1-20
R50	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
R52	000563	RES	CARBON	56 K	5%	1/4 W	OHMITE	RC07GF563J
R53	000273	RES	CARBON	27 K	5%	1/4 W1	OHMITE	RC07GF273J
R54	000273	RES	CARBON	27 K	5%	1/4 W1	OHMITE	RC07GF273J
R55	000163	RES	CARBON	16 K	5%	1/4 W1	OHMITE	RC07GF163J
R56	000104	RES	CARBON	100 K	5%	1/4 W1	OHMITE	RC07GF104J
R57	000163	RES	CARBON	16 K	5%	1/4 W1	OHMITE	RC07GF163J
R58	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R59	000123	RES	CARBON	12 K	5%	1/4 W1	OHMITE	RC07GF123J
R60	000202	RES	CARBON	2 K	5%	1/4 W1	OHMITE	RC07GF202J
R61	000431	RES	CARBON	430 OHM	5%	1/4 W1	OHMITE	RC07GF431J
R62	000202	RES	CARBON	2 K	5%	1/4 W1	OHMITE	RC07GF202J
R63	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J

PARTS LIST

ASSEMBLY 402551

REF. DESIG.	PART NO.	DESCRIPTION				
CR1	211083	DIODE SILICO	018	1	DANA	211083
CR2	211083	DIODE SILICO	018	1	DANA	211083
CR3	211083	DIODE SILICO	018	1	DANA	211083
CR4	211083	DIODE SILICO	018	1	DANA	211083
CR5	211083	DIODE SILICO	018	1	DANA	211083
CR6	211083	DIODE SILICO	018	1	DANA	211083
CR7	211083	DIODE SILICO	018	1	DANA	211083
CR8	211083	DIODE SILICO	018	1	DANA	211083
CR9	211083	DIODE SILICO	018	1	DANA	211083
CR10	211083	DIODE SILICO	018	1	DANA	211083
CR11	211083	DIODE SILICO	018	1	DANA	211083
CR12	211083	DIODE SILICO	018	1	DANA	211083
CR13	210004	DIODE SILICO	SD4		DIODES IN SD4	
CR14	210004	DIODE SILICO	SD4		DIODES IN SD4	
CR15	211083	DIODE SILICO	018	1	DANA	211083
CR16	211083	DIODE SILICO	018	1	DANA	211083
CR17	211083	DIODE SILICO	018	1	DANA	211083
CR18	211083	DIODE SILICO	018	1	DANA	211083
CR19	211236	DIODE SILICO	007		DANA	211236
CR20	211236	DIODE SILICO	007		DANA	211236
CR21	221254	DIODE SILICO ZENER 1N961A		1	MOTOROLA	1N961A
CR22	221254	DIODE SILICO ZENER 1N961A		1	MOTOROLA	1N961A
C1	101641	CAP CERAM	470 PFD 500 V	10%1	AEROVOX	SCD1X5F
C2	121473	CAP MYLAR	.0015 MFD 100 V	10%1	CDE	WMF1S47
C3	110001	CAP TANTA	6.8 MFD 35 V	10%1	KEMET	K6R8C35K
C4	121473	CAP MYLAR	.0015 MFD 100 V	10%1	CDE	WMF1S47
C5	110001	CAP TANTA	6.8 MFD 35 V	10%1	KEMET	K6R8C35K
C6	101641	CAP CERAM	470 PFD 500 V	10%1	AEROVOX	SCD1X5F
C7	120094	CAP POLYS	.0051 MFD 500 V		CRL	CPR-5100J
F1	920054	FUSE	.1 AMP		BUSS	BMW 1/10
E-F2FUS	920280		.5 AMP		MICROFUSE	
K1	310013	RELAY REED	SPST 24V	1	WHEELOCK	2961A X6
K2	310013	RELAY REED	SPST 24V	1	WHEELOCK	2961A X6
K3	310013	RELAY REED	SPST 24V	1	WHEELOCK	2961A X6
K4	310013	RELAY REED	SPST 24V	1	WHEELOCK	2961A X6
Q1	200035	TRANS SILICO NPN	014		DANA	200035
Q2	200035	TRANS SILICO NPN	014		DANA	200035
Q3	200035	TRANS SILICO NPN	014		DANA	200035

PARTS LIST

ASSEMBLY 402551

REF. DESIG.	PART NO.	DESCRIPTION							
Q4	200035	TRANS	SILICO NPN	014				DANA	200035
Q5	201084	TRANS	GERMAN PNP	2N1304			1	TI	2N1304
Q6	200036	TRANS	SILICO NPN	015				DANA	200036
Q7	200040	TRANS	SILICO NPN	016				DANA	200040
Q8	200040	TRANS	SILICO NPN	016				DANA	200040
Q9	200043	TRANS	SILICO NPN	2N3565				FAIRCHILD	2N3565
Q10	200043	TRANS	SILICO NPN	2N3565				FAIRCHILD	2N3565
Q11	200043	TRANS	SILICO NPN	2N3565				FAIRCHILD	2N3565
Q12	200022	TRANS	SILICO PNP	012				DANA	200022
Q13	200052	TRANS	SILICO PNP	009				DANA	200052
R8	000473	RES	CARBON	47 K	5%	1/4 W1		OHMITE	RC07GF473J
R9	010339	RES	METAL	10.104 MEG	.1%	1 W		PYROFILM	PME75
R10	000103	RES	CARBON	10 K	5%	1/4 W1		OHMITE	RC07GF103J
R11	010338	RES	METAL	1 MEG	1%	1 W		PYROFILM	PME75
R12	020403	RES	WW	201.0 K	.1%	1/8 W		JORDAN	J11
R13	020399	RES	WW	20.153 K	.1%	1/8 W		JORDAN	J11
R14	020400	RES	WW	2.0088 K	.1%	1/8 W		JORDAN	J11
R15	040004	RES	VARI	100 K	10%	1/5 W		BOURNS	3068-P-1-10
R16	020401	RES	WW	10.34 K	.1%	1/8 W		JORDAN	J11
R17	020386	RES	WW	10 K	.1%	1/8 W		JORDAN	J11
R18	040066	RES	VARI	1 K	10%	1/4 W		BOURNS	271-P-1-166
R19	040084	RES	VARI	200 OHM	10%	1/2 W		BOURNS	3067P-1-20
R20	040055	RES	VARI	500 K	10%	1/5 W		BOURNS	3068-P-1-50
R21	010158	RES	METAL	200 K	1%	1/4 W1		ELECTRA	RN60D2003F
R22	000432	RES	CARBON	4.3 K	5%	1/4 W1		OHMITE	RC07GF432J
R23	000511	RES	CARBON	510 OHM	5%	1/4 W1		OHMITE	RC07GF511J
R24	000103	RES	CARBON	10 K	5%	1/4 W1		OHMITE	RC07GF103J
R25	000681	RES	CARBON	680 OHM	5%	1/4 W1		OHMITE	RC07GF681J
R26	010139	RES	METAL	50 M	2%	1/4 W1		PYROFILM	PFR6627
R27	040004	RES	VARI	100 K	10%	1/5 W		BOURNS	3068-P-1-10
R28	010039	RES	METAL	9.09 K	1%	1/4 W		ELECTRA	RN60D9091F
R29	010236	RES	WW	10 MEG	1%	1 W1		PME	PME70T2
R30	040059	RES	VARI	1 M	10%	1/5 W		BOURNS	3068-P-1-10
R31	010236	RES	WW	10 MEG	1%	1 W1		PME	PME70T2
R32	010236	RES	WW	10 MEG	1%	1 W1		PME	PME70T2
R33	000513	RES	CARBON	51 K	5%	1/4 W1		OHMITE	RC07GF513J
R34	010158	RES	METAL	200 K	1%	1/4 W1		ELECTRA	RN60D2003F
R35	000202	RES	CARBON	2 K	5%	1/4 W1		OHMITE	RC07GF202J

PARTS LIST

ASSEMBLY 402551

REF. DESIG.	PART NO.	DESCRIPTION							
R36	000513	RES	CARBON	51 K	5%	1/4 W1	OHMITE	RC07GF513J
R37	000151	RES	CARBON	150 OHM	5%	1/4 W1	OHMITE	RC07GF151J
R38	000151	RES	CARBON	150 OHM	5%	1/4 W1	OHMITE	RC07GF151J
R39	000473	RES	CARBON	47 K	5%	1/4 W1	OHMITE	RC07GF473J
R40	000152	RES	CARBON	1.5 K	5%	1/4 W1	OHMITE	RC07GF152J
R41	000202	RES	CARBON	2 K	5%	1/4 W1	OHMITE	RC07GF202J
R42	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
R43	020119	RES	WW	680 OHM	1%	1/2 W1	CF ELEC	M-20
R44	000332	RES	CARBON	3.3 K	5%	1/4 W1	OHMITE	RC07GF332J
R45	000101	RES	CARBON	100 OHM	5%	1/4 W1	OHMITE	RC07GF101J
R46	001713	RES	FSV		5%	1/4 W	DANA	001713
R47	001713	RES	FSV		5%	1/4 W	DANA	001713
R48	001713	RES	FSV		5%	1/4 W	DANA	001713
R49	001713	RES	FSV		5%	1/4 W	DANA	001713
R50	001713	RES	FSV		5%	1/4 W	DANA	001713
R51	001713	RES	FSV		5%	1/4 W	DANA	001713
R52	020402	RES	WW	115 K	.1%	1/8 W	JURDAN	J11
R53	001713	RES	FSV		5%	1/4 W	DANA	001713

PARTS LIST

ASSEMBLY 402549 - **PC Board Assembly, Function Indicator**

REF. DESIG.	PART NO.	DESCRIPTION						
DS1	920116	LAMP	NEON	NE-2H			GE	MPG-250-3
DS2	920116	LAMP	NEON	NE-2H			GE	MPG-250-3
DS03	920116	LAMP	NEON	NE-2H			G E	MPG250-3
DS04	920116	LAMP	NEON	NE-2H			G E	MPG250-3
DS05	920116	LAMP	NEON	NE-2H			G E	MPG250-3
DS06	920116	LAMP	NEON	NE-2H			G E	MPG250-3
R46	000473	RES	CARBON	47 K	5%	1/4 W1	OHMITE	RC07GF473J
R47	000473	RES	CARBON	47 K	5%	1/4 W1	OHMITE	RC07GF473J
R48	000473	RES	CARBON	47 K	5%	1/4 W1	OHMITE	RC07GF473J
R49	000473	RES	CARBON	47 K	5%	1/4 W1	OHMITE	RC07GF473J
R50	000473	RES	CARBON	47 K	5%	1/4 W1	OHMITE	RC07GF473J
R51	000473	RES	CARBON	47 K	5%	1/4 W1	OHMITE	RC07GF473J

PARTS LIST

ASSEMBLY 402520

REF. DESIG.	PART NO.	DESCRIPTION						
C1	110041	CAP	ELECT	250 MFD	6 V	20%	DUCATI	250-6
CR1	210004	DIODE	SILICO	SD4			DIODES IN	SD4
CR2	210004	DIODE	SILICO	SD4			DIODES IN	SD4
CR3	210004	DIODE	SILICO	SD4			DIODES IN	SD4
R1	001107	RES	CARBON	39 K	5%	1 W	OHMITE	RC32GF393J
R2	001698	RES	CARBON	20 K	5%	1 W	OHMITE	RC32GF203J
R3	000224	RES	CARBON	220 K	5%	1/4 W1	OHMITE	RC07GF224J
R4	001107	RES	CARBON	39 K	5%	1 W	OHMITE	RC32GF393J
R5	001698	RES	CARBON	20 K	5%	1 W	OHMITE	RC32GF203J
R6	030005	RES	CARBON	100 K	5%	2 W	OHMITE	RC42GF104J
R7	030005	RES	CARBON	100 K	5%	2 W	OHMITE	RC42GF104J
R8	030005	RES	CARBON	100 K	5%	2 W	OHMITE	RC42GF104J
R9	030012	RES	CARBON	130 K	5%	1 W	OHMITE	RC32GF134J
R10	030012	RES	CARBON	130 K	5%	1 W	OHMITE	RC32GF134J
R11	030012	RES	CARBON	130 K	5%	1 W	OHMITE	RC32GF134J
R12	000914	RES	CARBON	910 K	5%	1/4 W	OHMITE	RC07GF914J
R13	000914	RES	CARBON	910 K	5%	1/4 W	OHMITE	RC07GF914J
R14	000914	RES	CARBON	910 K	5%	1/4 W	OHMITE	RC07GF914J
R15	000914	RES	CARBON	910 K	5%	1/4 W	OHMITE	RC07GF914J
R16	000914	RES	CARBON	910 K	5%	1/4 W	OHMITE	RC07GF914J
R17	000914	RES	CARBON	910 K	5%	1/4 W	OHMITE	RC07GF914J
R18	000914	RES	CARBON	910 K	5%	1/4 W	OHMITE	RC07GF914J

PARTS LIST

ASSEMBLY 400891

REF. DESIG.	PART NO.	DESCRIPTION				
CR1	211083	DIODE SILICO	018	1	DANA	211083
CR2	211083	DIODE SILICO	018	1	DANA	211083
CR3	211083	DIODE SILICO	018	1	DANA	211083
CR4	211083	DIODE SILICO	018	1	DANA	211083
CR5	211083	DIODE SILICO	018	1	DANA	211083
CR6	211083	DIODE SILICO	018	1	DANA	211083
CR7	211083	DIODE SILICO	018	1	DANA	211083
CR8	211083	DIODE SILICO	018	1	DANA	211083
CR9	211083	DIODE SILICO	018	1	DANA	211083
CR10	211083	DIODE SILICO	018	1	DANA	211083
CR11	211083	DIODE SILICO	018	1	DANA	211083
CR12	211083	DIODE SILICO	018	1	DANA	211083
CR13	211083	DIODE SILICO	018	1	DANA	211083
CR14	211083	DIODE SILICO	018	1	DANA	211083
CR15	211083	DIODE SILICO	018	1	DANA	211083
CR16	211083	DIODE SILICO	018	1	DANA	211083
CR17	211083	DIODE SILICO	018	1	DANA	211083
CR18	211083	DIODE SILICO	018	1	DANA	211083
CR19	211083	DIODE SILICO	018	1	DANA	211083
CR20	211083	DIODE SILICO	018	1	DANA	211083
CR21	211083	DIODE SILICO	018	1	DANA	211083
CR22	211083	DIODE SILICO	018	1	DANA	211083
CR23	211083	DIODE SILICO	018	1	DANA	211083
CR24	211083	DIODE SILICO	018	1	DANA	211083
CR25	211083	DIODE SILICO	018	1	DANA	211083
CR36	211083	DIODE SILICO	018	1	DANA	211083
CR37	211083	DIODE SILICO	018	1	DANA	211083
CR38	211083	DIODE SILICO	018	1	DANA	211083
CR39	211083	DIODE SILICO	018	1	DANA	211083
CR40	211083	DIODE SILICO	018	1	DANA	211083
CR41	211083	DIODE SILICO	018	1	DANA	211083
CR42	211083	DIODE SILICO	018	1	DANA	211083
CR43	211083	DIODE SILICO	018	1	DANA	211083
CR44	211083	DIODE SILICO	018	1	DANA	211083
CR45	211083	DIODE SILICO	018	1	DANA	211083
CR46	211083	DIODE SILICO	018	1	DANA	211083
CR47	211083	DIODE SILICO	018	1	DANA	211083
CR48	211083	DIODE SILICO	018	1	DANA	211083

PARTS LIST

ASSEMBLY 400891

REF. DESIG.	PART NO.	DESCRIPTION							
C01	100012	CAP	CERAM	33 PFD 500 V		10%		AEROVOX	TCD-N750
Q01	200037	TRANS	SILICO NPN	2N3646				FAIRCHILD	2N3646
Q02	200037	TRANS	SILICO NPN	2N3646				FAIRCHILD	2N3646
Q04	200035	TRANS	SILICO NPN	014				DANA	200035
R01	000122	RES	CARBON	1.2 K		5%	1/4 W1	OHMITE	RC07GF122J
R02	000153	RES	CARBON	15 K		5%	1/4 W1	OHMITE	RC07GF153J
R03	000122	RES	CARBON	1.2 K		5%	1/4 W1	OHMITE	RC07GF122J
R04	000153	RES	CARBON	15 K		5%	1/4 W1	OHMITE	RC07GF153J
R08	000243	RES	CARBON	24 K		5%	1/4 W1	OHMITE	RC07GF243J
R09	000273	RES	CARBON	27 K		5%	1/4 W1	OHMITE	RC07GF273J
R11	000204	RES	CARBON	200 K		5%	1/4 W	OHMITE	RC07GF204J
R12	000103	RES	CARBON	10 K		5%	1/4 W1	OHMITE	RC07GF103J
R13	000103	RES	CARBON	10 K		5%	1/4 W1	OHMITE	RC07GF103J
R14	001698	RES	CARBON	20 K		5%	1 W	OHMITE	RC32GF203J
R15	001107	RES	CARBON	39 K		5%	1 W	OHMITE	RC32GF393J
R16	000103	RES	CARBON	10 K		5%	1/4 W1	OHMITE	RC07GF103J
R17	000103	RES	CARBON	10 K		5%	1/4 W1	OHMITE	RC07GF103J
R18	000103	RES	CARBON	10 K		5%	1/4 W1	OHMITE	RC07GF103J
R19	001107	RES	CARBON	39 K		5%	1 W	OHMITE	RC32GF393J
R20	001698	RES	CARBON	20 K		5%	1 W	OHMITE	RC32GF203J
R21	000103	RES	CARBON	10 K		5%	1/4 W1	OHMITE	RC07GF103J
R22	000103	RES	CARBON	10 K		5%	1/4 W1	OHMITE	RC07GF103J
R23	000103	RES	CARBON	10 K		5%	1/4 W1	OHMITE	RC07GF103J
R24	000103	RES	CARBON	10 K		5%	1/4 W1	OHMITE	RC07GF103J
R25	000103	RES	CARBON	10 K		5%	1/4 W1	OHMITE	RC07GF103J
R26	000103	RES	CARBON	10 K		5%	1/4 W1	OHMITE	RC07GF103J
R27	000223	RES	CARBON	22 K		5%	1/4 W	OHMITE	RC07GF223J
R28	000223	RES	CARBON	22 K		5%	1/4 W	OHMITE	RC07GF223J
R29	000223	RES	CARBON	22 K		5%	1/4 W	OHMITE	RC07GF223J
R30	000223	RES	CARBON	22 K		5%	1/4 W	OHMITE	RC07GF223J
R31	000683	RES	CARBON	68 K		5%	1/4 W1	OHMITE	RC07GF683J
R32	000563	RES	CARBON	56 K		5%	1/4 W	OHMITE	RC07GF563J
R33	000473	RES	CARBON	47 K		5%	1/4 W1	OHMITE	RC07GF473J
R34	000473	RES	CARBON	47 K		5%	1/4 W1	OHMITE	RC07GF473J
R35	000473	RES	CARBON	47 K		5%	1/4 W1	OHMITE	RC07GF473J
R36	000473	RES	CARBON	47 K		5%	1/4 W1	OHMITE	RC07GF473J
R37	000473	RES	CARBON	47 K		5%	1/4 W1	OHMITE	RC07GF473J
R38	000204	RES	CARBON	200 K		5%	1/4 W	OHMITE	RC07GF204J

PARTS LIST

ASSEMBLY 400896

REF. DESIG.	PART NO.	DESCRIPTION						
CR1	211083	DIODE SILICO		018		1	DANA	211083
CR2	211083	DIODE SILICO		018		1	DANA	211083
Q01	200037	TRANS SILICO NPN		2N3646			FAIRCHILD	2N3646
Q02	200055	TRANS SILICO NPN		FSV			DANA	200055
Q03	200067	TRANS		PNP		019	DANA	200067
R01	000473	RES	CARBON	47 K	5%	1/4 W1	OHMITE	RC07GF473J
R02	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R03	000753	RES	CARBON	75 K	5%	1/4 W	OHMITE	RC07GF753J
R04	000204	RES	CARBON	200 K	5%	1/4 W	OHMITE	RC07GF204J
R05	010033	RES	METAL	49.9 K	1%	1/4 W	ELECTRA	RN60D4992F
R6	000104	RES	CARBON	100 K	5%	1/4 W1	OHMITE	RC07GF104J
R07	000104	RES	CARBON	100 K	5%	1/4 W1	OHMITE	RC07GF104J
R08	000204	RES	CARBON	200 K	5%	1/4 W	OHMITE	RC07GF204J
R09	010290	RES	METAL	180 K	1%	1/4 W	ELECTRA	RN60D1803F
R10	020078	RES	WW	50 K	.1%	1/8 W	JORDAN	J-11
R11	010291	RES	METAL	100 K	.25%	1/2 W	PYROFILM	PME65T100K
R12	010291	RES	METAL	100 K	.25%	1/2 W	PYROFILM	PME65T100K
R13	010292	RES	METAL	200 K	.25%	1/2 W	PYROFILM	PME65T200K
R14	020121	RES	WW	180 K	.1%	1/8 W	JORDAN	J-11
R15	021103	RES	WW	50 K	.05%	1/4 W	KELVIN	EP-21
R16	020242	RES	WW	100 K	.05%	1/4 W	JORDAN	J12
R17	020242	RES	WW	100 K	.05%	1/4 W	JORDAN	J12
R18	020243	RES	WW	200 K	.05%	1/4 W	JORDAN	J12
R19	000203	RES	CARBON	20 K	5%	1/4 W1	OHMITE	RC07GF203J

ASSEMBLY 400892 - **PC Board Assembly - Null Detector**

REF. DESIG.	PART NO.	DESCRIPTION					
CR1	211083	DIODE SILICO	018		1	DANA	211083
CR2	211083	DIODE SILICO	018		1	DANA	211083
CR3	211083	DIODE SILICO	018		1	DANA	211083
CR4	211083	DIODE SILICO	018		1	DANA	211083
CR5	211083	DIODE SILICO	018		1	DANA	211083
CR6	211083	DIODE SILICO	018		1	DANA	211083
CR7	211083	DIODE SILICO	018		1	DANA	211083
CR8	211083	DIODE SILICO	018		1	DANA	211083
CR9	211083	DIODE SILICO	018		1	DANA	211083
CR10	220004	DIODE SILICO ZENER	1N961B		1	MOTOROLA	1N961B
CR11	211083	DIODE SILICO	018		1	DANA	211083
C01	110047	CAP ELECT	50 MFD	50 V	20*	DUCATI	50-50
C02	110047	CAP ELECT	50 MFD	50 V	20*	DUCATI	50-50
C03	110043	CAP ELECT	25 MFD	25 V	20*	DUCATI	25-25
C04	101175	CAP CERAM	220 PFD	500 V	10*1	AEROVOX	SCD1X5F
C05	110043	CAP ELECT	25 MFD	25 V	20*	DUCATI	25-25
C06	101642	CAP CERAM	150 PFD	500 V	10*1	AEROVOX	SCD2X5F
C07	110043	CAP ELECT	25 MFD	25 V	20*	DUCATI	25-25
C08	110017	CAP TANTA	1 MFD	35 V	10*1	KEMET	K1C35K
C09	111097	CAP ELECT	50 MFD	50 V	20*1	SPRAGUE	TE1307
C10	111097	CAP ELECT	50 MFD	50 V	20*1	SPRAGUE	TE1307
C11	121092	CAP MYLAR	.0022 MFD	100 V	10*	CDE	WMF1D22
Q01	200037	TRANS SILICO NPN	2N3646			FAIRCHILD	2N3646
Q02	200054	TTRANS SILICO NPN	FSV			DANA	200054
Q03	200067	TRANS	PNP		019	DANA	200067
Q04	200037	TRANS SILICO NPN	2N3646			FAIRCHILD	2N3646
Q05	200054	TTRANS SILICO NPN	FSV			DANA	200054
Q06	200035	TRANS SILICO NPN	014			DANA	200035
Q07	200011	TRANS SILICO PNP	009			DANA	200011
Q08	200036	TRANS SILICO NPN	015			DANA	200036
Q09	200040	TRANS SILICO NPN	016			DANA	200040
Q10	200037	TRANS SILICO NPN	2N3646			FAIRCHILD	2N3646
Q11	200037	TRANS SILICO NPN	2N3646			FAIRCHILD	2N3646
Q12	200037	TRANS SILICO NPN	2N3646			FAIRCHILD	2N3646
Q13	200037	TRANS SILICO NPN	2N3646			FAIRCHILD	2N3646
Q14	200022	TRANS SILICO PNP	012			DANA	200022
Q15	200037	TRANS SILICO NPN	2N3646			FAIRCHILD	2N3646
Q16	200037	TRANS SILICO NPN	2N3646			FAIRCHILD	2N3646

PARTS LIST

ASSEMBLY 400892 - **PC Board Assembly - Null Detector**

REF. DESIG.	PART NO.	DESCRIPTION						
Q17	200043	TRANS	SILICO NPN	2N3565			FAIRCHILD	2N3565
R01	000473	RES	CARBON	47 K	5%	1/4 W1	OHMITE	RC07GF473J
R02	000123	RES	CARBON	12 K	5%	1/4 W1	OHMITE	RC07GF123J
R03	000563	RES	CARBON	56 K	5%	1/4 W	OHMITE	RC07GF563J
R04	000473	RES	CARBON	47 K	5%	1/4 W1	OHMITE	RC07GF473J
R05	000203	RES	CARBON	20 K	5%	1/4 W1	OHMITE	RC07GF203J
R06	000823	RES	CARBON	82 K	5%	1/4 W1	OHMITE	RC07GF823J
R07	040004	RES	VARI	100 K	10U	1/5 W	BOURNS	3068-P-1-10
R08	020244	RES	WW	MATCH SET			DANA	020244
R09	020123	RES	WW	10 K	.01%	1/8 W	JORDAN	J11
R10	020334	RES	WW.	4897.4 OHM	.05%	1/8 W	JORDAN	J11
R11	020244	RES	WW	MATCH SET			DANA	020244
R12	000102	RES	CARBON	1 K	5%	1/4 W1	OHMITE	RC07GF102J
R13	000102	RES	CARBON	1 K	5%	1/4 W1	OHMITE	RC07GF102J
R14	000102	RES	CARBON	1 K	5%	1/4 W1	OHMITE	RC07GF102J
R15	000102	RES	CARBON	1 K	5%	1/4 W1	OHMITE	RC07GF102J
R16	000516	RES	CARBON	51 M	5%	1/4 W	OHMITE	RC07GF516J
R17	020244	RES	WW	MATCH SET			DANA	020244
R18	000201	RES	CARBON	200 OHM	5%	1/4 W1	OHMITE	RC07GF201J
R19	000201	RES	CARBON	200 OHM	5%	1/4 W1	OHMITE	RC07GF201J
R20	020244	RES	WW	MATCH SET			DANA	020244
R21	000622	RES	CARBON	6.2 K	5%	1/4 W1	OHMITE	RC07GF622J
R22	010167	RES	METAL	442 K	1%	1/4 W1	ELECTRA	RN60D4423F
R23	020244	RES	WW	MATCH SET			DANA	020244
R24	040005	RES	VARI	10 K	10%	1/2 W	BOURNS	3067-P-1-10
R25	010295	RES	WW	2 MEG	1%			RN20X
R26	000123	RES	CARBON	12 K	5%	1/4 W1	OHMITE	RC07GF123J
R27	010167	RES	METAL	442 K	1%	1/4 W1	ELECTRA	RN60D4423F
R28	020244	RES	WW	MATCH SET			DANA	020244
R29	020244	RES	WW	MATCH SET			DANA	020244
R30	000225	RES	CARBON	2.2 M	5%	1/4 W	OHMITE	RC07GF225J
R31	000104	RES	CARBON	100 K	5%	1/4 W1	OHMITE	RC07GF104J
R32	000114	RES	CARBON	110 K	5%	1/4 W	OHMITE	RC07GF114J
R33	001711	RES	FSV		5%	1/4 W	DANA	001711
R34	020244	RES	WW	MATCH SET			DANA	020244
R35	000104	RES	CARBON	100 K	5%	1/4 W1	OHMITE	RC07GF104J
R36	000225	RES	CARBON	2.2 M	5%	1/4 W	OHMITE	RC07GF225J
R37	000331	RES	CARBON	330 OHM	5%	1/4 W1	OHMITE	RC07GF331J

PARTS LIST

ASSEMBLY 400892 - **PC Board Assembly - Null Detector**

REF. DESIG.	PART NO.	DESCRIPTION						
R38	001711	RES	FSV		5%	1/4 W	DANA	001711
R39	020244	RES	WW	MATCH SET			DANA	020244
R40	000102	RES	CARBON	1 K	5%	1/4 W1	OHMITE	RC07GF102J
R41	000302	RES	CARBON	3 K	5%	1/4 W1	OHMITE	RC07GF302J
R42	000273	RES	CARBON	27 K	5%	1/4 W1	OHMITE	RC07GF273J
R43	000512	RES	CARBON	5.1 K	5%	1/4 W1	OHMITE	RC07GF512J
R44	001711	RES	FSV		5%	1/4 W	DANA	001711
R45	020244	RES	WW	MATCH SET			DANA	020244
R46	000391	RES	CARBON	390 OHM	5%	1/4 W	OHMITE	RC07GF391J
R47	000183	RES	CARBON	18 K	5%	1/4 W1	OHMITE	RC07GF183J
R48	001711	RES	FSV		5%	1/4 W	DANA	001711
R49	020244	RES	WW	MATCH SET			DANA	020244
R50	001692	RES	CARBON	4.7 K	5%	1/2 W	OHMITE	RC20GF472J
R51	001711	RES	FSV		5%	1/4 W	DANA	001711
R52	020244	RES	WW	MATCH SET			DANA	020244
R53	001283	RES	CARBON	5.1 K	5%	1/2 W1	OHMITE	RC20GF512J
R54	001692	RES	CARBON	4.7 K	5%	1/2 W	OHMITE	RC20GF472J
R55	001711	RES	FSV		5%	1/4 W	DANA	001711
R56	020244	RES	WW	MATCH SET			DANA	020244
R57	000303	RES	CARBON	30 K	5%	1/4 W1	OHMITE	RC07GF303J
R58	000124	RES	CARBON	120 K	5%	1/4 W1	OHMITE	RC07GF124J
R59	000392	RES	CARBON	0003.9 K	5%	1/4 W1	OHMITE	RC07GF392J
R60	000101	RES	CARBON	100 OHM	5%	1/4 W1	OHMITE	RC07GF101J
R61	000101	RES	CARBON	100 OHM	5%	1/4 W1	OHMITE	RC07GF101J
R62	000201	RES	CARBON	200 OHM	5%	1/4 W1	OHMITE	RC07GF201J
R63	001711	RES	FSV		5%	1/4 W	DANA	001711
R64	000473	RES	CARBON	47 K	5%	1/4 W1	OHMITE	RC07GF473J
R65	000133	RES	CARBON	13 K	5%	1/4 W1	OHMITE	RC07GF133J
H-R65	000682	RES	CARBON	6.8 K	5%	1/4 W1	OHMITE	RC07GF682J

PARTS LIST

ASSEMBLY 400894

REF. DESIG.	PART NO.	DESCRIPTION						
CR1	211083	DIODE	SILICO	018	1		DANA	211083
CR2	211083	DIODE	SILICO	018	1		DANA	211083
CR3	211083	DIODE	SILICO	018	1		DANA	211083
CR4	211083	DIODE	SILICO	018	1		DANA	211083
CR5	211083	DIODE	SILICO	018	1		DANA	211083
CR6	211083	DIODE	SILICO	018	1		DANA	211083
CR7	211083	DIODE	SILICO	018	1		DANA	211083
CR8	211083	DIODE	SILICO	018	1		DANA	211083
CR9	211083	DIODE	SILICO	018	1		DANA	211083
CR10	211083	DIODE	SILICO	018	1		DANA	211083
CR11	211083	DIODE	SILICO	018	1		DANA	211083
CR12	211083	DIODE	SILICO	018	1		DANA	211083
CR25	211083	DIODE	SILICO	018	1		DANA	211083
CR37	211083	DIODE	SILICO	018	1		DANA	211083
CR38	211083	DIODE	SILICO	018	1		DANA	211083
CR39	211083	DIODE	SILICO	018	1		DANA	211083
CR40	211083	DIODE	SILICO	018	1		DANA	211083
CR41	211083	DIODE	SILICO	018	1		DANA	211083
CR42	211083	DIODE	SILICO	018	1		DANA	211083
CR43	211083	DIODE	SILICO	018	1		DANA	211083
CR44	211083	DIODE	SILICO	018	1		DANA	211083
C01	100012	CAP	CERAM	33 PFD 500 V	10%		AEROVOX	TCD-N750
V-C01	100010	CAP	CERAM	68 PFD 500 V	10%		AERVOX	TCD-N750
C03	101182	CAP	CERAM	47 PFD 500 V	10%1		AEROVOX	TCD-N750
C04	120011	CAP	POLYS	.068 MFD 100 V	10%		CDE	WMF1568
C05	120011	CAP	POLYS	.068 MFD 100 V	10%		CDE	WMF1568
C06	120011	CAP	POLYS	.068 MFD 100 V	10%		CDE	WMF1568
Q01	200037	TRANS	SILICO NPN	2N3646			FAIRCHILD	2N3646
Q02	200037	TRANS	SILICO NPN	2N3646			FAIRCHILD	2N3646
Q07	200037	TRANS	SILICO NPN	2N3646			FAIRCHILD	2N3646
Q08	200037	TRANS	SILICO NPN	2N3646			FAIRCHILD	2N3646
Q09	200037	TRANS	SILICO NPN	2N3646			FAIRCHILD	2N3646
Q10	200037	TRANS	SILICO NPN	2N3646			FAIRCHILD	2N3646
R01	000222	RES	CARBON	2.2 K	5%	1/4 W1	OHMITE	RC07GF222J
R02	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R03	000222	RES	CARBON	2.2 K	5%	1/4 W1	OHMITE	RC07GF222J
R04	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R08	000123	RES	CARBON	12 K	5%	1/4 W1	OHMITE	RC07GF123J

PARTS LIST

ASSEMBLY 400894

REF. DESIG.	PART NO.	DESCRIPTION							
A-R08	000243	RES	CARBON	24 K	5%	1/4 W1	OHMITE	RC07GF243J
B-R08	000243	RES	CARBON	24 K	5%	1/4 W1	OHMITE	RC07GF243J
R10	000273	RES	CARBON	27 K	5%	1/4 W1	OHMITE	RC07GF273J
R14	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R15	000273	RES	CARBON	27 K	5%	1/4 W1	OHMITE	RC07GF273J
R16	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
R17	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R18	000104	RES	CARBON	100 K	5%	1/4 W1	OHMITE	RC07GF104J
R19	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
R20	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R21	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R22	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R23	000273	RES	CARBON	27 K	5%	1/4 W1	OHMITE	RC07GF273J
R24	000333	RES	CARBON	33 K	5%	1/4 W	OHMITE	RC07GF333J
R25	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J

PARTS LIST

ASSEMBLY 402501

REF. DESIG.	PART NO.	DESCRIPTION						
CR1	211083	DIODE SILICO	018		1	DANA	211083
CR2	211083	DIODE SILICO	018		1	DANA	211083
CR3	211083	DIODE SILICO	018		1	DANA	211083
CR13	211083	DIODE SILICO	018		1	DANA	211083
CR14	211083	DIODE SILICO	018		1	DANA	211083
CR24	211083	DIODE SILICO	018		1	DANA	211083
CR25	211083	DIODE SILICO	018		1	DANA	211083
CR37	211083	DIODE SILICO	018		1	DANA	211083
CR38	211083	DIODE SILICO	018		1	DANA	211083
CR39	211083	DIODE SILICO	018		1	DANA	211083
CR40	211083	DIODE SILICO	018		1	DANA	211083
CR41	211083	DIODE SILICO	018		1	DANA	211083
CR42	211083	DIODE SILICO	018		1	DANA	211083
CR43	211083	DIODE SILICO	018		1	DANA	211083
CR44	211083	DIODE SILICO	018		1	DANA	211083
CR45	211083	DIODE SILICO	018		1	DANA	211083
CR46	211083	DIODE SILICO	018		1	DANA	211083
CR47	211083	DIODE SILICO	018		1	DANA	211083
CR48	211083	DIODE SILICO	018		1	DANA	211083
CR49	211083	DIODE SILICO	018		1	DANA	211083
CR50	211083	DIODE SILICO	018		1	DANA	211083
C1	100012	CAP CERAM	33 PFD 500 V		10%	AEROVOX	TCD-N750
K-C1	101145	CAP CERAM	100 PFD 500 V		10%1	AEROVOX	SCD1X5F
C3	121093	CAP MYLAR	.047 MFD 100 V		10%1	CDE	WMF1S47
C4	121473	CAP MYLAR	.0015 MFD 100 V		10%1	CDE	WMF1S47
C5	121473	CAP MYLAR	.0015 MFD 100 V		10%1	CDE	WMF1S47
C6	121090	CAP MYLAR	.015 MFD 100 V		10%1	CDE	WMF1S15
C7	110017	CAP TANTA	1 MFD 35 V		10%1	KEMET	K1C35K
C8	110017	CAP TANTA	1 MFD 35 V		10%1	KEMET	K1C35K
C9	110017	CAP TANTA	1 MFD 35 V		10%1	KEMET	K1C35K
C10	110043	CAP ELECT	25 MFD 25 V		20%	DUCATI	25-25
Q1	200037	TRANS SILICO NPN		2N3646		FAIRCHILD	2N3646
Q2	200037	TRANS SILICO NPN		2N3646		FAIRCHILD	2N3646
Q7	200037	TRANS SILICO NPN		2N3646		FAIRCHILD	2N3646
Q8	200037	TRANS SILICO NPN		2N3646		FAIRCHILD	2N3646
Q09	200037	TRANS SILICO NPN		2N3646		FAIRCHILD	2N3646
Q10	200037	TRANS SILICO NPN		2N3646		FAIRCHILD	2N3646
Q11	200011	TRANS SILICO PNP		009		DANA	200011

PARTS LIST

ASSEMBLY 402501

REF. DESIG.	PART NO.	DESCRIPTION						
Q12	200037	TRANS	SILICO NPN	2N3646			FAIRCHILD	2N3646
Q13	200037	TRANS	SILICO NPN	2N3646			FAIRCHILD	2N3646
Q14	200037	TRANS	SILICO NPN	2N3646			FAIRCHILD	2N3646
Q15	200037	TRANS	SILICO NPN	2N3646			FAIRCHILD	2N3646
Q16	200037	TRANS	SILICO NPN	2N3646			FAIRCHILD	2N3646
Q17	200037	TRANS	SILICO NPN	2N3646			FAIRCHILD	2N3646
Q18	200037	TRANS	SILICO NPN	2N3646			FAIRCHILD	2N3646
R1	000222	RES	CARBON	2.2 K	5%	1/4 W1	OHMITE	RC07GF222J
R2	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R3	000222	RES	CARBON	2.2 K	5%	1/4 W1	OHMITE	RC07GF222J
R4	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R8	000123	RES	CARBON	12 K	5%	1/4 W1	OHMITE	RC07GF123J
R9	000204	RES	CARBON	200 K	5%	1/4 W	OHMITE	RC07GF204J
R10	000273	RES	CARBON	27 K	5%	1/4 W1	OHMITE	RC07GF273J
R16	000122	RES	CARBON	1.2 K	5%	1/4 W1	OHMITE	RC07GF122J
R17	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R18	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
R19	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
R20	000122	RES	CARBON	1.2 K	5%	1/4 W1	OHMITE	RC07GF122J
R21	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R22	000201	RES	CARBON	200 OHM	5%	1/4 W1	OHMITE	RC07GF201J
R24	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R25	000104	RES	CARBON	100 K	5%	1/4 W1	OHMITE	RC07GF104J
R26	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
R27	000622	RES	CARBON	6.2 K	5%	1/4 W1	OHMITE	RC07GF622J
R28	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R29	000242	RES	CARBON	2.4 K	5%	1/4 W1	OHMITE	RC07GF242J
R30	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J
R31	000104	RES	CARBON	100 K	5%	1/4 W1	OHMITE	RC07GF104J
R32	000122	RES	CARBON	1.2 K	5%	1/4 W1	OHMITE	RC07GF122J
R33	000221	RES	CARBON	220 OHM	5%	1/4 W1	OHMITE	RC07GF221J
R34	000203	RES	CARBON	20 K	5%	1/4 W1	OHMITE	RC07GF203J
R35	000203	RES	CARBON	20 K	5%	1/4 W1	OHMITE	RC07GF203J
R36	000122	RES	CARBON	1.2 K	5%	1/4 W1	OHMITE	RC07GF122J
R37	000104	RES	CARBON	100 K	5%	1/4 W1	OHMITE	RC07GF104J
R38	000752	RES	CARBON	7.5 K	5%	1/4 W1	OHMITE	RC07GF752J
R39	000104	RES	CARBON	100 K	5%	1/4 W1	OHMITE	RC07GF104J
R40	000222	RES	CARBON	2.2 K	5%	1/4 W1	OHMITE	RC07GF222J

PARTS LIST

ASSEMBLY 402501

REF. DESIG.	PART NO.	DESCRIPTION							
R41	000133	RES	CARBON	13 K	5%	1/4 W1	OHMITE	RC07GF133J
R42	040003	RES	VARI	20 K	10%	1/2 W	BOURNS	3067-P-1-20
R43	000222	RES	CARBON	2.2 K	5%	1/4 W1	OHMITE	RC07GF222J
R44	000104	RES	CARBON	100 K	5%	1/4 W1	OHMITE	RC07GF104J
R45	000243	RES	CARBON	24 K	5%	1/4 W1	OHMITE	RC07GF243J
R46	000822	RES	CARBON	8.2 K	5%	1/4 W1	OHMITE	RC07GF822J
R47	000103	RES	CARBON	10 K	5%	1/4 W1	OHMITE	RC07GF103J
R48	000103	RES	CARBON	10 K	5%	1/4 W1	OHMITE	RC07GF103J
R49	000103	RES	CARBON	10 K	5%	1/4 W1	OHMITE	RC07GF103J
R50	000103	RES	CARBON	10 K	5%	1/4 W1	OHMITE	RC07GF103J
R51	000273	RES	CARBON	27 K	5%	1/4 W1	OHMITE	RC07GF273J

PARTS LIST

ASSEMBLY 400895

REF. DESIG.	PART NO.	DESCRIPTION						
CR1	220007	DIODE SILICO ZENER 1N751				1	MOTOROLA	1N751
CR2	211236	DIODE SILICO	007				DANA	211236
CR4	211083	DIODE SILICO	018			1	DANA	211083
CR5	211083	DIODE SILICO	018			1	DANA	211083
CR6	211083	DIODE SILICO	018			1	DANA	211083
CR7	211083	DIODE SILICO	018			1	DANA	211083
CR8	211083	DIODE SILICO	018			1	DANA	211083
CR9	211083	DIODE SILICO	018			1	DANA	211083
CR10	220012	DIODE SILICO ZENER 1N958B				1	MOTOROLA	1N958B
CR11	220004	DIODE SILICO ZENER 1N961B				1	MOTOROLA	1N961B
CR12	211083	DIODE SILICO	018			1	DANA	211083
CR13	211083	DIODE SILICO	018			1	DANA	211083
CR14	211083	DIODE SILICO	018			1	DANA	211083
CR15	211083	DIODE SILICO	018			1	DANA	211083
CR16	211083	DIODE SILICO	018			1	DANA	211083
CR17	210004	DIODE SILICO	SD4				DIODES IN SD4	
C01	101145	CAP CERAM	100 PFD	500 V		10%1	AEROVOX	SC01X5F
C02	101145	CAP CERAM	100 PFD	500 V		10%1	AEROVOX	SC01X5F
C03	101642	CAP CERAM	150 PFD	500 V		10%1	AEROVOX	SC02X5F
C05	110017	CAP TANTA	1 MFD	35 V		10%1	KEMET	K1C35K
C06	110001	CAP TANTA	6.8 MFD	35 V		10%1	KEMET	K6R8C35K
C07	101641	CAP CERAM	470 PFD	500 V		10%1	AEROVOX	SCD1X5F
C08	101641	CAP CERAM	470 PFD	500 V		10%1	AEROVOX	SCD1X5F
C09	110036	CAP ELECT	25 MFD	50 V		20%	DUCATI	25-50
C10	110036	CAP ELECT	25 MFD	50 V		20%	DUCATI	25-50
C11	110038	CAP ELECT	50 MFD	15 V		20%	DUCATI	50-15
C12	110038	CAP ELECT	50 MFD	15 V		20%	DUCATI	50-15
C13	110007	CAP TANTA	6 MFD	25 V		20%1	GE	29F56664
C14	120001	CAP MYLAR	.0033 MFD	100 V		10%1	CDE	WMF1D33
C15	110007	CAP TANTA	6 MFD	25 V		20%1	GE	29F56664
C16	121093	CAP MYLAR	.047 MFD	100 V		10%1	CDE	WMF1S47
C17	121088	CAP MYLAR	.01 MFD	100 V		10%	CDE	WMF1S1
C18	101145	CAP CERAM	100 PFD	500 V		10%1	AEROVOX	SC01X5F
C19	101642	CAP CERAM	150 PFD	500 V		10%1	AEROVOX	SC02X5F
K01	310021	RELAY DC	2 PDT	24V		1	ALLIED	AZ42056105
Q01	200036	TRANS SILICO NPN	015				DANA	200036
Q02	200043	TRANS SILICO NPN	2N3565				FAIRCHILD	2N3565
Q03	200035	TRANS SILICO NPN	014				DANA	200035

PARTS LIST

ASSEMBLY 400895

REF. DESIG.	PART NO.	DESCRIPTION							
Q04	200044	TRANS	SILICO NPN DUAL FSV					DANA	200044
Q05	200044	TRANS	SILICO NPN DUAL FSV					DANA	200044
Q06	200043	TRANS	SILICO NPN	2N3565				FAIRCHILD	2N3565
Q07	200011	TRANS	SILICO PNP	009				DANA	200011
Q08	200043	TRANS	SILICO NPN	2N3565				FAIRCHILD	2N3565
Q09	200040	TRANS	SILICO NPN	016				DANA	200040
Q10	200040	TRANS	SILICO NPN	016				DANA	200040
Q11	200043	TRANS	SILICO NPN	2N3565				FAIRCHILD	2N3565
Q12	200022	TRANS	SILICO PNP	012				DANA	200022
Q13	200043	TRANS	SILICO NPN	2N3565				FAIRCHILD	2N3565
Q14	200011	TRANS	SILICO PNP	009				DANA	200011
Q15	200011	TRANS	SILICO PNP	009				DANA	200011
Q16	200011	TRANS	SILICO PNP	009				DANA	200011
Q17	200022	TRANS	SILICO PNP	012				DANA	200022
R01	000512	RES	CARBON	5.1 K	5%	1/4 W1		OHMITE	RC07GF512J
R05	001733	RES	CARBON	3.6 OHM	5%	1/4 W		OHMITE	RC07GF3R6J
R06	000126	RES	CARBON	12 M	5%	1/4 W		OHMITE	RC07GF126J
R07	020123	RES	WW	10 K	.01%	1/8 W		JORDAN	J11
R08	040050	RES	VARI	5 K	10%	1/2 W		BOURNS	3067-P-1-K0
R09	020123	RES	WW	10 K	.01%	1/8 W		JORDAN	J11
R10	040003	RES	VARI	20 K	10%	1/2 W		BOURNS	3067-P-1-20
R12	000681	RES	CARBON	680 OHM	5%	1/4 W1		OHMITE	RC07GF681J
R13	000107	RES	CARBON	100 M	5%	1/4 W		OHMITE	RC07GF107J
R14	000107	RES	CARBON	100 M	5%	1/4 W		OHMITE	RC07GF107J
R15	001674	RES	CARBON	680 OHM	5%	1/2 W1		OHMITE	RC20GF681J
R16	010145	RES	METAL	324 K	1%	1/4 W1		ELECTRA	RN60C3243F
R17	040054	RES	VARI	50 K	10%	1/5 W		BOURNS	3068-P-1503
R18	010091	RES	METAL	11 K	1%	1/4 W1		ELECTRA	RN60D1102F
R19	010145	RES	METAL	324 K	1%	1/4 W1		ELECTRA	RN60C3243F
R20	000680	RES	CARBON	68 OHM	5%	1/4 W		OHMITE	RC07GF680J
R21	000242	RES	CARBON	2.4 K	5%	1/4 W1		OHMITE	RC07GF242J
R22	000242	RES	CARBON	2.4 K	5%	1/4 W1		OHMITE	RC07GF242J
R23	000565	RES	CARBON	5.6 M	5%	1/4 W1		OHMITE	RC07GF565J
R24	000335	RES	CARBON	3.3 M	5%	1/4 W1		OHMITE	RC07GF335J
R25	000822	RES	CARBON	8.2 K	5%	1/4 W1		OHMITE	RC07GF822J
R26	000101	RES	CARBON	100 OHM	5%	1/4 W1		OHMITE	RC07GF101J
R27	010114	RES	METAL	4.02 K	1%	1/4 W		ELECTRA	RN60D4021F
R28	010114	RES	METAL	4.02 K	1%	1/4 W		ELECTRA	RN60D4021F

PARTS LIST

ASSEMBLY 400895

REF. DESIG.	PART NO.	DESCRIPTION							
R29	010299	RES	METAL	12 K	1%	1/4 W	ELECTRA	RN60D1202F
R30	010300	RES	METAL	750 OHM	1%	1/4 W	ELECTRA	RN60D7500F
R31	000101	RES	CARBON	100 OHM	5%	1/4 W1	OHMITE	RC07GF101J
R32	000161	RES	CARBON	160 OHM	5%	1/4 W	OHMITE	RC07GF161J
R33	000101	RES	CARBON	100 OHM	5%	1/4 W1	OHMITE	RC07GF101J
R34	000752	RES	CARBON	7.5 K	5%	1/4 W1	OHMITE	RC07GF752J
R35	000201	RES	CARBON	200 OHM	5%	1/4 W1	OHMITE	RC07GF201J
R36	000101	RES	CARBON	100 OHM	5%	1/4 W1	OHMITE	RC07GF101J
R37	000151	RES	CARBON	150 OHM	5%	1/4 W1	OHMITE	RC07GF151J
R38	000101	RES	CARBON	100 OHM	5%	1/4 W1	OHMITE	RC07GF101J
R39	000221	RES	CARBON	220 OHM	5%	1/4 W1	OHMITE	RC07GF221J
R40	000102	RES	CARBON	1 K	5%	1/4 W1	OHMITE	RC07GF102J
R41	000133	RES	CARBON	13 K	5%	1/4 W1	OHMITE	RC07GF133J
R42	000150	RES	CARBON	15 OHM	5%	1/4 W1	OHMITE	RC07GF150J
R43	000220	RES	CARBON	22 OHM	5%	1/4 W1	OHMITE	RC07GF220J
R44	000150	RES	CARBON	15 OHM	5%	1/4 W1	OHMITE	RC07GF150J
R45	001260	RES	CARBON	3.9 K	5%	1/2 W	OHMITE	RC20GF392J
R46	000150	RES	CARBON	15 OHM	5%	1/4 W1	OHMITE	RC07GF150J
R47	000122	RES	CARBON	1.2 K	5%	1/4 W1	OHMITE	RC07GF122J
R48	020359	RES	WW	13.8 K	.01%	1/8 W	JORDAN	J11
R49	000153	RES	CARBON	15 K	5%	1/4 W1	OHMITE	RC07GF153J

PARTS LIST

ASSEMBLY 402522

REF. DESIG.	PART NO.	DESCRIPTION							
CR1	210004	DIODE SILICO	SD4					DIODES IN SD4	
CR2	210004	DIODE SILICO	SD4					DIODES IN SD4	
CR3	210004	DIODE SILICO	SD4					DIODES IN SD4	
CR4	210004	DIODE SILICO	SD4					DIODES IN SD4	
CR5	210004	DIODE SILICO	SD4					DIODES IN SD4	
CR6	210004	DIODE SILICO	SD4					DIODES IN SD4	
CR7	210004	DIODE SILICO	SD4					DIODES IN SD4	
CR8	210004	DIODE SILICO	SD4					DIODES IN SD4	
CR9	210004	DIODE SILICO	SD4					DIODES IN SD4	
CR10	210004	DIODE SILICO	SD4					DIODES IN SD4	
CR11	210004	DIODE SILICO	SD4					DIODES IN SD4	
CR12	210004	DIODE SILICO	SD4					DIODES IN SD4	
CR13	210004	DIODE SILICO	SD4					DIODES IN SD4	
CR14	210004	DIODE SILICO	SD4					DIODES IN SD4	
CR15	210004	DIODE SILICO	SD4					DIODES IN SD4	
CR16	210004	DIODE SILICO	SD4					DIODES IN SD4	
CR17	210004	DIODE SILICO	SD4					DIODES IN SD4	
CR18	220015	DIODE SILICO ZENER	1N967B					MOTOROLA	1N967B
CR19	220015	DIODE SILICO ZENER	1N967B					MOTOROLA	1N967B
C1	121088	CAP MYLAR	.01 MFD	100 V	10%			CDE	WMF1S1
C2	121088	CAP MYLAR	.01 MFD	100 V	10%			CDE	WMF1S1
C3	121088	CAP MYLAR	.01 MFD	100 V	10%			CDE	WMF1S1
C4	121088	CAP MYLAR	.01 MFD	100 V	10%			CDE	WMF1S1
C5	120072	CAP MYLAR	.01 MFD	600 V	10%			CDE	WMF651
C14	110041	CAP ELECT	250 MFD	6 V	20%			DUCATI	250-6
C15	110036	CAP ELECT	25 MFD	50 V	20%			DUCATI	25-50
C16	110036	CAP ELECT	25 MFD	50 V	20%			DUCATI	25-50
C17	101174	CAP CERAM	.001 MFD	500 V	10%1			AEROVOX	SCD3X5F
C18	101174	CAP CERAM	.001 MFD	500 V	10%1			AEROVOX	SCD3X5F
Q1	200035	TRANS SILICO NPN	014					DANA	200035
Q2	200011	TRANS SILICO PNP	009					DANA	200011
R1	031450	RES CARBON	220 K			5%	2 W	OHMITE	RC42GF224J
R2	030008	RES CARBON	200 OHM			5%	3 W	OHMITE	4399
R3	000202	RES CARBON	2 K			5%	1/4 W1	OHMITE	RC07GF202J
R4	000202	RES CARBON	2 K			5%	1/4 W1	OHMITE	RC07GF202J
R5	000151	RES CARBON	150 OHM			5%	1/4 W1	OHMITE	RC07GF151J
R6	000151	RES CARBON	150 OHM			5%	1/4 W1	OHMITE	RC07GF151J
R7	030007	RES CARBON	150 OHM			5%	3 W	OHMITE	4396

PARTS LIST

ASSEMBLY 402522

REF. DESIG.	PART NO.	DESCRIPTION						
R8	030007	RES	CARBON	150 OHM	5%	3 W	OHMITE	4396

DANA™